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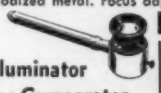

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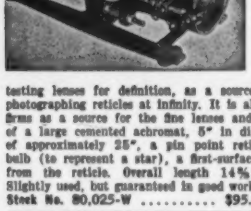

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Polyene Antibiotics

William Oroshnik, Leo C. Vining, Alexander D. Mebane, Willard A. Taber

Ortho Research Foundation, Raritan, New Jersey, and
Institute of Microbiology, Rutgers, University, New Brunswick, New Jersey

DURING the past few years a considerable number of antibiotics of a highly unsaturated nature have been isolated. Of these, mycomycin (I), agrocybin (II), and diatretyne I (III), have had their structures elucidated, and the highly unsaturated constituent of fumagillin (IV), has been shown to be 2,4,6,8-decatetraene-1,10-dioic acid.

$$HC{\equiv}C{-}C{\equiv}C{-}CH{=}C{=}CH{-}CH{=}CH{-}CH_2COOH \quad (I)$$

$$CH_3{-}C{\equiv}C{-}C{\equiv}C{-}C{\equiv}C{-}CONH_2 \quad (II)$$

$$HOOC{-}CH{=}CH{-}C{\equiv}C{-}C{\equiv}C{-}CONH_2 \quad (III)$$

$$HOOC{-}CH{=}CH{-}CH{=}CH{-}CH{=}CH{-}CH{=}CH{-}COOH \quad (IV)$$

These materials have aroused widespread interest since they represent the first examples of highly conjugated nonisoprenoid chromophores to be found among the products of microorganisms. The presence of conjugated polyenyne chromophores, such as those of (II) and (III), has also been demonstrated in the higher plants as far back as 1935 by Russian workers (*1*) and very recently by Sorensen and his coworkers (*2*).

Since 1950 a number of new antibiotic substances have been reported whose ultraviolet absorption spectra, while characteristic of highly conjugated systems, are nevertheless fundamentally different from those of polyenyne compounds. This is illustrated in Fig. 1. Despite this, workers in the field have continued to group all of these unsaturated antibiotics together.

It is our purpose here to point out that the new antibiotics can definitely be characterized as conjugated polyenes rather than polyenynes by their ultraviolet absorption spectra. Figures 2, 3, and 4 illustrate the very close relationship between the spectra of nystatin, flavacid, and candidin and those of known tetraene, hexaene, and heptaene (*3*) examples, respectively. In addition, the position of the wavelengths of the absorption maxima in these spectra indicates with fair certainty that the responsible chromophores are at least disubstituted and at most tetrasubstituted.

Table 1 gives the wavelengths of the absorption maxima of nine recently isolated antibiotics. These show wave number separations of 140–152 mm^{-1} and 139–155 mm^{-1} characteristic of conjugated polyene systems. They fall into three distinct groups, each of which appears to contain the same chromophore. In the first, this is a tetraene (Fig. 2). Although possessing an identical chromophoric group, rimocidin and actimycoin are known to be different from nystatin and from each other. Flavacid, the only member of the second group so far reported, contains a hexaene (Fig. 3). In the third group, the chromophore is a heptaene (Fig. 4). Of these four antibiotics, candidin and candicidin have been proved different; ascosin and trichomycin are very similar to candicidin but cannot as yet be proved identical or nonidentical with it. A number of other antifungal agents with the same absorption spectrum have been isolated but not as yet reported.

Although fumagillin is also a polyene antibiotic (*3*), it nevertheless differs significantly in several respects from the polyene antibiotics just discussed. Its absorption curve (Fig. 5) shows considerably less fine structure than is seen in the curves of the others, which would indicate that the carboxyl groups in the polyene acid (IV) are conjugated with the chromophore. The effect of a conjugated carbonyl on the fine structure of the absorption spectrum is clearly illustrated in Figs. 4 and 5. Preliminary chemical evi-

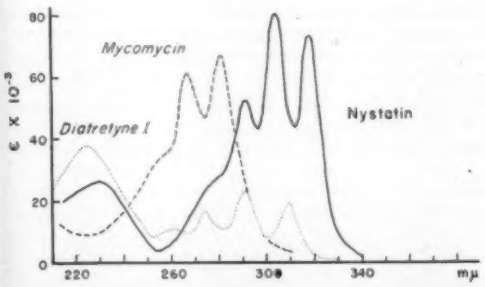

Fig. 1. Ultraviolet absorption spectra of polyunsaturated antibiotics, in ethanol or methanol. [Redrawn from references cited in text.]

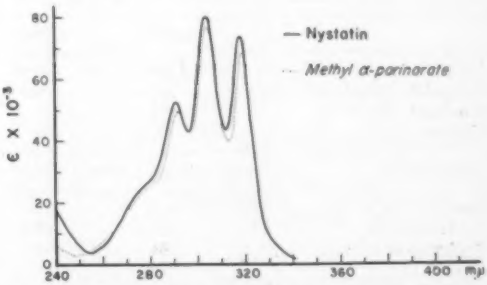

Fig. 2. Ultraviolet absorption spectra, in ethanol, of nystatin and methyl α-parinarate, $C_5H_{11}(CH{:}CH)_4(CH_2)_7COOMe$ [J. P. Riley, *J. Chem. Soc.* 2579 (1951)].

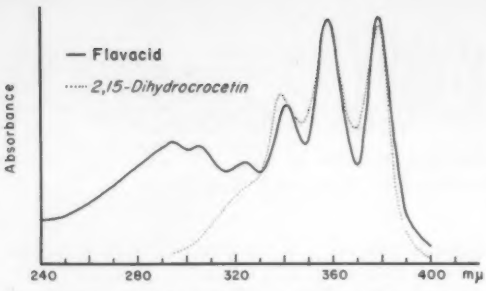

Fig. 3. Ultraviolet absorption spectra, in ethanol, of flavacid and 2,15-dihydrocrocetin, HOOC—CH(Me)—CH: CH—CH: C(Me)—CH: CH—CH: CH—C(Me): CH—CH: CH—CH(Me)COOH [A. Smakula, *Angew. Chem.* **47**, 657 (1934)]. The absorbance of the antibiotic is arbitrarily shown as equal to that of the reference compound.

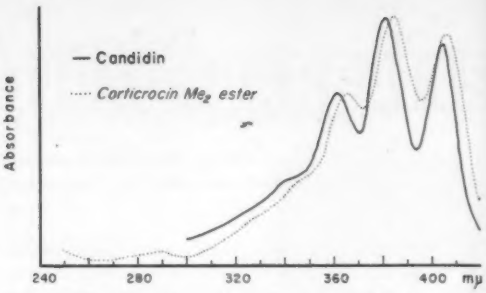

Fig. 4. Ultraviolet absorption spectra, in ethanol, of candidin and corticrocin dimethyl ester, MeOOC(CH: CH)$_6$COOMe [H. Erdtman, *Acta Chem. Scand.* **2**, 209 (1948)]; curve corrected for bathochromic effect of chloroform solvent used. The absorbance of the antibiotic is arbitrarily shown as equal to that of the reference compound.

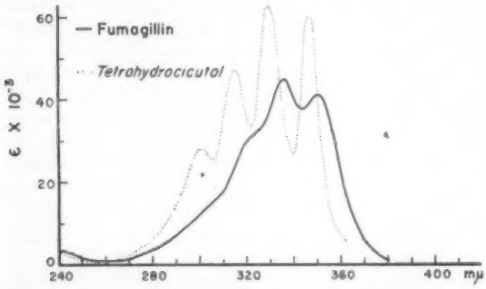

Fig. 5. Ultraviolet absorption spectra, in ethanol, of fumagillin and tetrahydrocicutol, $C_4H_9(CH: CH)_3CH_2CH_2CH_2OH$ [E. F. L. J. Anet, *et al.*, *J. Chem. Soc.* 309 (1953)].

dence obtained with candicidin corroborates the spectral evidence that its acidity is not due to a conjugated carboxyl group.

In addition fumagillin shows a totally different antibiotic spectrum from those of the other substances listed in Table 1. The latter are characterized by high activity against the yeasts and fungi and a very low order of activity against most other microorganisms. It is also noteworthy that fumagillin is a product of the mold *Aspergillus fumigatus*, and the remaining substances have all been isolated from streptomycetes and represent a high proportion of the antifungal antibiotics so far isolated from this genus. It appears therefore, that at least two distinct types of antibiotics containing a conjugated polyene system exist in nature.

References and Notes

1. V. V. Williams, V. S. Smirnov, and V. P. Gol'mov, *J. Gen. Chem.* (*U.S.S.R.*) **5**, 1195 (1935).
2. N. A. Sorensen *et al.*, *Acta Chem. Scand.* **8**, 26, 34, 280 (1954).
3. Although corticrocin contains eight conjugated double bonds, two of these being derived from carboxyl groups, its spectrum indicates, in line with A. Smakula's generalization [*Angew. Chem.* **47**, 657 (1934)] that only one of the carbonyl groups shows the spectral effects of conjugation. Hence, corticrocin exhibits the spectrum of a conjugated heptaene rather than an octaene and is used here for want of a better example. Fumagillin, for the same reason, shows the spectrum of a conjugated pentaene rather than a hexaene.
4. F. Raubitscheck, R. F. Acker, and S. A. Waksman, *Antibiotics & Chemotherapy* **2**, 179 (1952).
5. E. L. Hazen and R. Brown, *Proc. Soc. Exptl. Biol. Med.* **76**, 93 (1951).

Table 1. Absorption spectra of polyene antibiotics.

	λ_1(mμ)	λ_2(mμ)	λ_3(mμ)	$\bar{\nu}_1 - \bar{\nu}_2$(mm^{-1})	$\bar{\nu}_2 - \bar{\nu}_3$(mm^{-1})	Solvent
Antimycoin (*4*)	291	304–5	318	152	139	EtOH
Fungicidin (Nystatin) (*5, 6*)	292	304.5	318	141	139	EtOH
Rimocidin (*7*)	291	304	318	147	144	80% MeOH
Chromin (*8*)	292.5	305	320	140	154	EtOH
Flavacid (*9*)	341	358	379	141	155	EtOH
Candidin (*10*)	363	383	406	144	148	EtOH
Candicidin (*11*)	359.5	379.5	401.5	147	146	EtOH
Trichomycin (*12*)	364	384	406	143	141	EtOH
Ascosin (*13*)	358	377	399	141	146	MeOH
Fumagillin (*14*)	$322_{infl.}$*	336	351	130	120	EtOH

* Inflection point.

6. J. D. Dutcher, G. Boyack, and S. Fox, *Antibiotics Annual, 1953–1954* (Medical Encyclopaedia, New York), p. 191.
7. J. W. Dawisson *et al.*, *Antibiotics & Chemotherapy* **1**, 289 (1951).
8. S. Wakaki *et al.*, *J. Antibiotics (Japan)* **6B**, 247 (1953).
9. Spectra taken on a sample kindly supplied by J. Takahashi, Tohoku University, Japan.
10. W. A. Taber, L. C. Vining, and S. A. Waksman, *Antibiotics & Chemotherapy* **4**, 455 (1954).
11. H. Lechevalier *et al.*, *Mycologia* **45**, 155 (1953). The wavelengths of the absorption maxima of different batches of candicidin vary somewhat. Those given refer to a specimen prepared by the Heyden Chemical Co.
12. S. Hosoya, *J. Antibiotics (Japan)* **5**, 564 (1952).
13. R. J. Hickey *et al.*, *Antibiotics & Chemotherapy* **2**, 472 (1952).
14. T. E. Eble and E. R. Hanson, *Antibiotics & Chemotherapy* **1**, 54 (1951).

University of Pennsylvania Radiocarbon Dates I

Elizabeth K. Ralph

University Museum and *Department of Physics, University of Pennsylvania, Philadelphia*

CONSTRUCTION of a carbon-14 dating laboratory at the University of Pennsylvania was started in October 1951 (*1*). The equipment is essentially the same as that developed by Anderson, Arnold, and Libby (*2*). Numerous sieges of contamination and other minor difficulties have delayed the completion of the first series of results until this time.

Initial and subsequent control measurements have been made with "dead" anthracite and modern wood samples. With the exception of periods of contamination, the anthracite samples have shown no net counts greater than two σ different from the background rates which have varied between 4.0 and 7.0 counts/min. The modern wood determinations were lower than expected (*3*). Therefore, archeological samples of known age were measured as shown in Fig. 1. The line through these points is drawn with the C^{14} half-life slope [5568 ± 30 yr (*4*)]. Eight determinations of 10- to 50-yr old modern wood from New Jersey and Pennsylvania have given an average value of 6.42 ± 0.04 counts/min; two runs of young poplar from Afghanistan, 6.37 ± 0.12 counts/min. The graph of known-age samples indicates that the basis for the time scale should be higher. Since the unknown samples are comparable in physical and chemical characteristics to those of known age rather than to modern wood, it was decided to base the age calculations on the figure obtained from the archeological measurements. (This corresponds to the assumption of a value of 6.70 ± 0.10 counts/min for modern wood). When more data are available from this and other laboratories, it is hoped that this discrepancy will be clarified.

The error listed with each age includes the standard error σ and the ± 0.10 uncertainty for the time scale. Counting times have been limited to 48 hr. The prefix "P-" is used to designate the sample numbers for this laboratory. The letters *a*, *b*, or *c* following a number represent the 2nd, 3rd, or 4th portion of a particular sample. A separate counting run has been made on each portion.

The caves that have been dated were excavated by Carleton S. Coon. Belt Cave was first excavated in 1949 (*5*). Samples of charred bone then taken were dated by Libby (*6*). In 1951 Belt Cave was excavated further, and work at Hotu Cave was begun. The samples dated in this laboratory consisted of charcoal collected from many levels in both caves. In the few cases where these dates correspond with levels dated by Libby, it must be remembered that his samples were charred bone, collected in 1949, whereas the ones in the present list were charcoal, obtained in 1951.

Belt (*Ghar-i-kamarband*) and Hotu are two neighboring caves eroded out of Jurassic limestone by wave action during some early high-water period of the Caspian Sea. They are situated in the face of a limestone erop just south of the railroad and motor roads on the southern Caspian shore of Iran, 4½ mi west of Behshahr and an equal distance south of the present shoreline, at about latitude 36°20′ N, longitude 53°35′ E, just east of the modern village of Turujan. The unexcavated floor of Belt Cave lay 15.42 m above the 1951 Caspian shoreline; that of Hotu, 18.37 m. The rock-bottom of Belt, which was reached by excavation, lies 9.7 m above this line, and the lowest point reached in excavating Hotu was 6.0 m above this line.

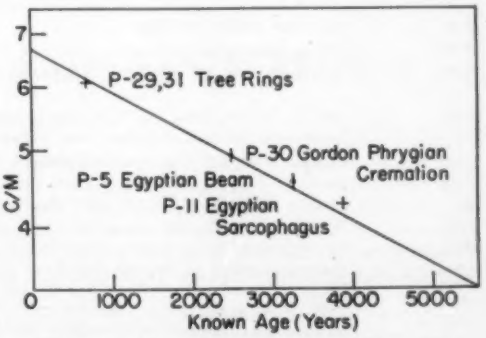

Fig. 1. Counting rates for samples of known age.

No.	Sample	Age (yr)
I.	*Belt Cave*	
P-19 P-19a P-19b	Strip C′, 95 to 105 cm, Software Neolithic. This level contains Neolithic artifacts, including a soft, burnished pottery and indirect evidences of agriculture and animal husbandry. The principal animals are sheep and goat.	[7015 ± 405 7395 ± 495 7430 ± 460] Average, 7280 ± 260
P-26 P-26a	Strip C′, 150 to 160 cm, bottom of Preceramic Neolithic. This level contains indirect evidence of agriculture and bones of sheep and goat.	[7680 ± 470 7905 ± 475] Average, 7790 ± 330
P-24 P-24a	Strip C′, 175 to 190 cm, Gazelle Mesolithic. Below a soil change, this level contains a fauna dominated by *Gazella subgutterosa* with a distinctive Mesolithic industry. The level corresponds to Libby's sample No. 574, dated 8545 ± 500 yr (*7*).	[8785 ± 575 8360 ± 510] Average, 8570 ± 380
P-27	Strip C′, 200 to 230 cm, yellow soil. A lens of coarse, apparently windborne loess separating the cultural levels above and below it and containing few artifacts.	12,275 ± 825
P-20 P-20b	Strip C′, 230 to 250 cm, Seal Mesolithic. A flint workship with implements similar to Solecki's Shanidar B-1 in northern Iraq. The fauna is dominated by a small species of seal (*Phoca* sp.) and includes a large breed of domestic (?) dog (*Canis familiaris*). The level corresponds to Arnold and Libby's samples No. 492 and 547, a mixture of which dated 8004 ± 900 yr (*4*).	[11,400 ± 800 11,550 ± 750] Average, 11,480 ± 550
II.	*Hotu Cave*	
P-18	Upper black soil (subsurface). Excavated from trench C at the sealed mouth of the cave, this sample represents the most recent occupation, in post-Achaemenian and pre-Islamic times.	Trench C, 1220 ± 230
P-43	190 to 200 cm, level 10, Iron Age. Also post-Achaemenian and pre-Islamic, this level contains unstudied late Iron Age pottery and the bones of sheep, goat, ox, pig, and red deer (*Cervus elaphus*).	Trench A, 2200 ± 280
P-44	200 to 240 cm, Iron Age. The dates for samples P-44, P-14 and 14a, P-32 and 32a, P-15a, P-17 and 17a, P-41, P-33 and 33a, and P-52, obtained from samples lying between two major soil changes and internally consistent, cover the archeological horizon between extreme dates of 750 and 1230 B.C.	Trench B, 2970 ± 270
P-14 P-14a	310 to 320 cm, level 19, early Iron Age. 310 to 320 cm, level 19, early Iron Age.	[Trench A, 2880 ± 340 Trench A, 2485 ± 235] Average, 2685 ± 210
P-32 P-32a	380 to 400 cm, level 25, early Iron Age. 380 to 400 cm, level 25, early Iron Age.	[Trench A, 2500 ± 260 Trench A, 2890 ± 310] Average, 2695 ± 200
P-15a	400 to 415 cm, level 26, early Iron Age.	Trench A, 2775 ± 315
P-17 P-17a	415 to 430 cm, level 27, early Iron Age. 415 to 430 cm, level 27, early Iron Age.	[Trench A, 2975 ± 345 Trench A, 2650 ± 340] Average, 2810 ± 290
P-41	400 + cm, early Iron Age.	Trench B, 2890 ± 370
P-33 P-33a	440 to 460 cm, level 29, early Iron Age. 440 to 460 cm, level 29, early Iron Age.	[Trench A, 3270 ± 390 Trench A, 2630 ± 260] Average, 2950 ± 230
P-52	500 to 520 cm, level 33. This sample was taken from a level with a large rock fall and contained some painted pottery.	Trench A, 2860 ± 380
P-45 P-34	Sample P-45, 535 + cm, painted pottery. Sample P-34, 520 to 590 cm, levels 34–38, painted pottery. These samples came from a horizon containing painted pottery, polished blackware, and burnished software.	Trench B, 6515 ± 425 Trench A, 4830 ± 480
P-35 P-36	Sample P-35, 590–660 cm, levels 39–41, software. Sample P-36, 580 + cm, software. These samples came from a Neolithic horizon containing software similar to that of Belt Cave (sample P-19) and containing bones of ox and pig as well as of sheep and goat. (The dates of samples P-52, P-34, and P-35, at variance with corresponding levels in trench B, have been checked for laboratory contamination. It is possible that these levels absorbed younger organic solutions that washed down from	Trench A, 4730 ± 320 Trench B, 6385 ± 425

No.	Sample	Age (yr)
	accumulations of bat dung above them. Trench A was in the back of the cave, behind trench B, where water collected).	
P-37 P-12 P-38 P-39	The remaining samples are from trench D of Hotu Cave, which underlies trenches A and B, below a marked soil change and an abrupt change of surface level. The C^{14} record gives a minimum of 910 and a maximum of 2610 yr for this time gap. Whereas the soils of trenches A and B are cultural deposits, those of trench D are geologic. The soil in trench D contains angular limestone rubble, which is rare or lacking above. The flints found in Gravels I to III, including those associated with sample P-37 (Gravel II), are extremely crude. The fauna consists largely of sheep, ox, and red deer. Whether or not the questionable and unproved site contamination of the levels above might also have extended into the underlying soils of trench D is unknown.	
P-37	765 cm, Gravel II (A-49), sub-Neolithic.	Trench D, 8070 ± 500
P-12	950 cm, Gravel IV, hearth under skeletons No. 2 and 3 (vole eaters). This sample consists of charcoal taken from the hearth under and associated with Hotu skeletons No. 2 and 3.	Trench D, 9190 ± 590
P-38	1015 cm, Black under Red I (vole eaters). The next hearth down in the red gravels, and nearly identical in time with P-12, makes these two levels a chronological unit. Culturally the vole eaters are represented by only 19 implements—too few for certain identification. The fauna, except for a few possible intrusions at the top, consists entirely of vermin and small birds, notably the mole-vole (*Ellobius* sp.), and thrush (*Turdus turdus*). Although they are roughly contemporaneous with the gazelle hunters of Belt Cave (sample P-24, 24a), these vermin-collectors cannot, on the basis of present evidence, be considered to have been the same people.	Trench D, 9220 ± 570
P-39	1115 cm, Black under Red II (seal hunters?). A hearth lower down in the red soil complex, apparently contemporaneous with the Seal Mesolithic of Belt Cave (sample P-20, 20b). Its industry, a blade culture, is also inconclusive, but could have resembled that of the Seal Mesolithic of Belt. These men hunted both seal and gazelle. In an even lower level for which we have no charcoal was found one bone of a giant wild ox (*Bos primigenius*).	Trench D, $11{,}860 \pm 840$

References and Notes

1. I wish to express my gratitude to Gaylord P. Harnwell, president of the University of Pennsylvania, and to Froelich G. Rainey, director of the University Museum, for the initiation and generous support of this laboratory; to William E. Stephens, professor of physics, for his invaluable advice; and to Carleton S. Coon, curator of general ethnology, for preparing the descriptions of the caves and for his advice. I also wish to express my appreciation to W. F. Libby for allowing me to work in his laboratory in October 1951, and for his advice.

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Existence of Periods in the Stock Market

Fred B. Daniels

Red Bank, New Jersey

THE existence of periods in economic time series still seems to be a subject of controversy. A recently published book (*1*) claims that periods of 3½, 9, 18, and 54 yr (as well as a few others) can be demonstrated in certain economic series and suggests various physical phenomena, including sunspots, as underlying causes. On the other hand, E. B. Wilson (*2*) has found that neither the periodogram technique nor the autocorrelation function gave any evidence of periodicity in the *Ayres Index of American Business Activity*. Wilson's negative results are not surprising, however, considering the nature of the Ayres index; it is a composite of a number of individual series, and the con-

stituents have not been the same throughout the entire period under consideration (1790–1930).

Many claims have been made regarding the existence of periods in the prices of common stocks. Some fairly convincing evidence of a 9-yr period in one index of common-stock prices does exist (*1*, p. 91). A description of a mechanism that could account for a period of this magnitude is to be found in a study by Smith and Erdley (*3*) of a closely related parameter, namely, the rate of flow of investment capital. By means of measurements performed on an electronic analog of Kalecki's model of an economic system, Smith and Erdley found that the system was unstable and oscillated with a 10-yr period.

Oscillations of the type that are observed in the Smith-Erdley analog are not caused by an impressed periodic force but are transient oscillations of a resonant system that is excited by random "noise." Such filtered noise constitutes a time series of the type that is called a stationary random function. Stationary random functions have been studied exhaustively by Wiener (*4*), who has demonstrated that they are predictable (in a statistical sense), and Bode and Shannon (*5*) have published a simplified derivation of the Wiener theory which provides a physical insight into the mechanism of prediction. Using the Wiener theory as a basis, Lee and Stutt (*6*) have constructed an electronic system that predicts filtered noise for the simple case of a tuned filter with a single resonant frequency.

I selected the *New York Times* "Index of industrial stocks" (*7*) for a search for periods. The autocorrelation function was chosen as a tool, because autocorrelation analysis is preferable to the periodogram technique or to Fourier analysis for investigating the possibility of prediction. The specific time series adopted was composed of the mid-year and year-end closing prices for the period 1911–52, inclusive. In common with most other industrial stock indices, the *New York Times* index, when plotted logarithmically, appears to oscillate about a straight line which corresponds to a 3-percent per annum rise. In order to express the times series in terms of oscillations about this line as an axis, the index values were therefore divided by $(1.03)^t$, where t is elapsed time in years. The autocorrelation function was computed from the defining relationship in the form

$$\phi(\tau) = \frac{1}{T-\tau}\int_0^{T-\tau} f(t)f(t+\tau)\,dt,$$

in which the averaging takes place over the interval $T-\tau$, which decreases as τ increases. This method results in increased accuracy for small values of τ and is therefore particularly valuable in detecting small-amplitude periods of short duration in the presence of longer periods of large amplitude.

Curve *A* of Fig. 1 is a plot of the normalized values of $\phi(\tau)$ for the *New York Times* index. The oscillation which has peaks at 0, 11, and 22 yr indicates that $f(t)$ behaves like the output of a tuned filter resonant at 11 yr and excited by random noise. No periods shorter than 11 yr are in evidence. A period that is a multiple of 11 yr could be present but would be difficult to detect because it would be too large a fraction of the time interval covered by the data. The fact that $\phi(0)$ is much greater than the amplitude with which the curve oscillates indicates the presence of considerable additional random noise superimposed on the filtered noise. The trend toward negative values of $\phi(\tau)$ for very large values of τ could be due to the existence of a much longer period but could also be due to the fact that the arbitrary axis that was chosen is not a true equilibrium state (*8*).

Since the results demonstrated the complete absence of any periods shorter than 11 yr, a second computation was made, using a 2.5-yr running average of the price index. This is equivalent to distributing pur-

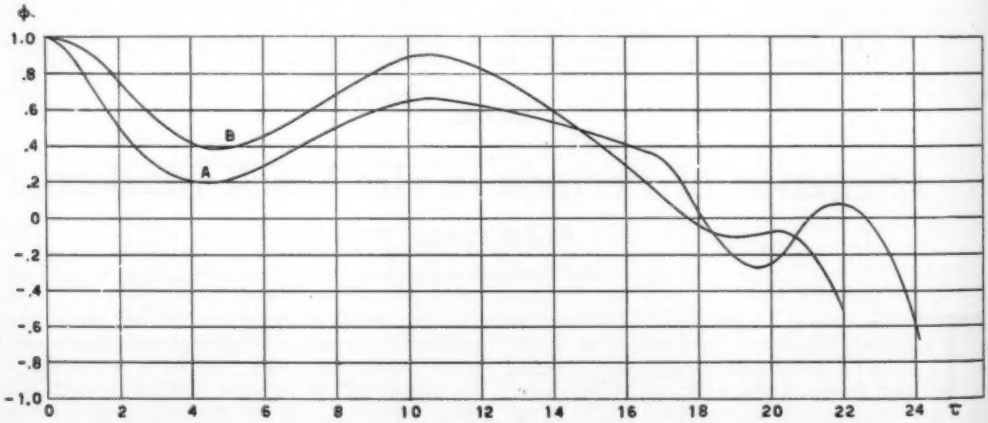

Fig. 1. Autocorrelation function of the *New York Times* index (1911–52): *A*, mid-year and year-end closing prices; *B*, 2.5-yr running average.

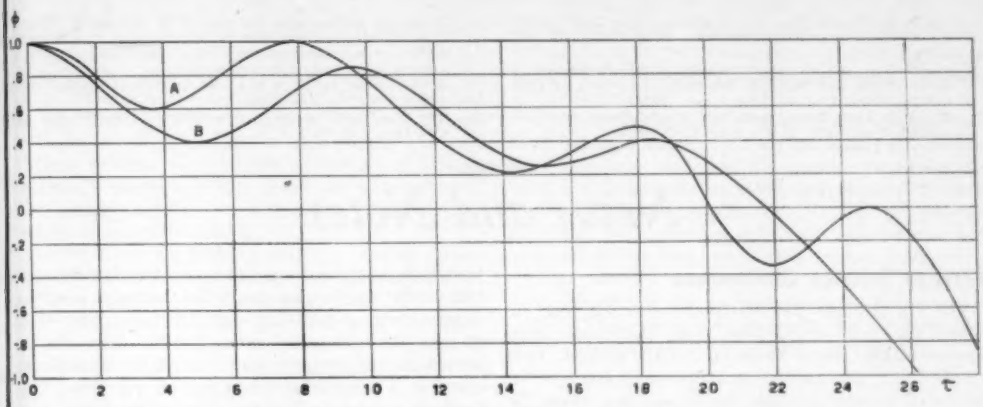

Fig. 2. Autocorrelation function of the Axe-Houghton index: *A*, 1855–1901; *B*, 1902–49.

hases or sales uniformly over the averaging interval nd has the effect of filtering out short-term fluctuaions. $\phi(\tau)$ for the running average is shown in Fig. B. The resonance period is now 10.5 years and the alue of the ordinate at $\tau = 10.5$, which gives the corelation between the smoothed price index at time t nd $t + 10.5$, is 0.9.

The time interval covered by the *New York Times* ndex is too short to give any information on whether r not the series is stationary (*9*). To obtain this information, therefore, the Axe-Houghton index (*10*), which has been compiled back to 1854, was selected. A 3-yr running average of this index was used, and the series was broken up into two intervals, covering the years 1855–1901 and 1902–49, inclusive. Figure 2 shows $\phi(\tau)$ for the two intervals. Although the general character of the two curves is the same, the mean period increased from 8 to 9.5 yr, and there was some change in the superimposed noise and in the degree of damping. The correlation between the index at a given time and its value one period later was 1.0 and 0.84 for the two intervals. (The value of 1.0 is so high that it is obviously fortuitous.) Although the series is not strictly stationary (and this is the criterion for predictability), the prediction theory could probably be applied, using average values for superimposed noise and damping and an extrapolated value for the period, if it were not for one other consideration. The results were obtained with respect to an arbitrarily chosen monotonically rising axis which does not represent a true equilibrium state. The application of the Wiener method involves the integration of $f(t)$, and large cumulative errors could be caused by an incorrectly chosen time-axis. It may be that some other economic series, perhaps in the form of a ratio, can eventually be found that does possess a natural equilibrium state or axis. If this series reflects the periodicity inherent in the Smith-Erdley analog, successful application of the Wiener method of prediction should be possible.

The information obtained from the foregoing analysis is of interest both to the economist and to the investor. To the economist, it demonstrates the existence of a period quite close to that predicted by Smith and Erdley and thus tends to strengthen the belief that the actual economic system does behave very much like the Kalecki model. To the investor, the results are chiefly of value in a negative sense. They demonstrate the existence of a 10-yr period but lead to the conclusion that application of the Wiener prediction method is not feasible because of the lack of information regarding the axis of the time function. The uncertainty regarding the axis, together with the masking effect of the superimposed noise, also almost completely rules out the possibility of a qualitative estimate of the future trend of the market. Finally, it should be emphasized that even if prediction of the stock market by Wiener's method were possible, the result would be purely statistical; that is, it would be the center of a probability distribution. An occasional large deviation would occur and, inasmuch as no period shorter than 10 yr is present, opportunities for averaging out a loss due to such a deviation would be few and far between.

Note added in proof. Subsequent to the preparation of this paper, an analysis was made of the Axe-Houghton index for the entire span 1854–1949. The autocorrelation function indicated the presence of an additional period, namely, one of 18 yr. The occurrence of this period can probably be attributed to a reflection in the stock market of the building construction cycle, which is known to have such a period.

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8. It can be shown that the use of an averaging interval that approaches zero for large values of τ will cause $\phi(\tau)$ to become negative if the true axis deviates in certain ways from the assumed axis.
9. A stationary series is one, the statistical properties of which are invariant with time.
10. The Axe-Houghton index is compiled by E. W. Axe and Co., Inc., 730 Fifth Ave., New York 19.

News and Notes

Alaskan Science Conference

The 5th Alaskan Science Conference was held in Anchorage 7–10 Sept. 1954, with the Cook Inlet Branch of the Alaska Division, AAAS, as host. Two hundred and thirty-seven registrants and many other interested persons attended the 26 sessions. About 25 percent of the participants were from outside Alaska, mainly the United States and Canada; one representative was from England.

Following the opening session when Warren Weaver, president of the AAAS, presented the main address, sessions embracing a well-rounded scientific program of 142 papers began. Perhaps the most consistent feature noted throughout the conference and present in all fields of science was the importance of scientific research to Alaska. It is evident that a great amount of scientific study is being applied today to various problems in Alaska. Many of these problems are unique to the North.

One of the four sessions on geology was devoted to special lectures on geochemical prospecting and exploration in Alaska. It was disclosed that such investigations have been conducted with success in southeastern Alaska. Also of interest were the papers by members of the U.S. Geological Survey that dealt with the petroleum and coal possibilities and ground water resources of the territory. Other papers in the geology sessions were "Engineering geology program of the U.S. Geological Survey in Alaska," "Quantitative measurements of the 1937 advance of Black Rapids Glacier, Alaska," "History and economic geology of copper deposits in Copper River areas, Alaska," and "Pyrite deposits at Horseshoe Bay, Latouche Island, Alaska."

The concluding geology session was a stimulating lecture by Geoffrey A. Kellaway, principal geologist of the British Geological Survey, on "Pleistocene structures in the British Isles." He reported that an examination of permafrost in Alaska revealed information that helped to explain the origin of many strange structures in the consolidated and unconsolidated rocks of England.

The remaining three sessions in the Physical Science Section were devoted to physics, geophysics, and meteorology, with several papers reporting latest findings in several fields of auroral research.

Among some of the interesting papers of the four sessions and two symposiums of the Social Sciences Section were those presented in the symposium on *Family Life*. It was reported that Alaska's first scientific mental health team concluded that most people in Alaska needing psychiatric services are under 40 yr of age. Juvenile delinquency studies were also reported in this symposium. Some of the papers presented in a valuable anthropology session were "Cape Denbigh archeology," "Archeology at Unalaska, Aleutians," "Copper River archeology," and "The potlach and social equilibrium."

A day-long session devoted to fisheries was one of the most stimulating of the sessions in the biological sciences. It was reported that Japanese fishermen, using fishing gear and methods that differ widely from American gear and methods, and operating in the North Pacific, caught more salmon during 1954 than in any other year since World War II. Another paper revealed that scientific studies of the commercial possibilities of fresh-water fish in Alaska shows an untapped fishery resource. Some idea of the wealth of information presented in the other biological science sessions may be visualized by noting such titles as "Beaver management in Alaska," "Influence of environmental temperature on acclimatized and nonacclimatized rats," and "Notes on the role of the Crustacea, especially Malacostraca, in arctic Alaskan waters." It was also reported in the biological sessions that research in Alaska revealed that the blood's chemical content changes under the influence of low temperatures. A day-long symposium entitled *Resource Planning in Northern Alaska—A Problem in Biological, Anthropological, Economic, Social and Moral Interrelationships* drew good attendance from a variety of persons interested in the use of renewable natural resources.

In sessions concerned with agriculture and forestry scientists discussed cause, control, and effect of fires on forests. Other papers in this section were, "Relationship of forest soils and site quality in southeast Alaska," "Use of the working circle concept in management of the national forests of southeast Alaska," "Physical properties and certain morphological features of potential agricultural soils of the upper Cook Inlet region," and "Socialized agriculture in U.S.S.R.: progress or failure."

An important and timely paper entitled "Report on poliomyelitis epidemic, St. Paul Island, Alaska" was presented at the session devoted to medicine and public health. This report stated that gamma globulin had no effect on the spread of polio on St. Paul Island. The island proved to be an ideal place for

studying the disease, for its extreme isolation made it possible to check all persons arriving or leaving. Other papers were concerned with the serious problem of tuberculosis in Alaska, and it was revealed that the outpatient method of treatment has been successful in the territory. Among the other papers presented in these sessions were "Study of anemia of Alaska Eskimos," "Appearance of intestinal wastes in surface water supplies at Ketchikan, Alaska," and "Adaptation to arctic cold."

In the three engineering sessions several papers were devoted to problems in the development of water power in Alaska, and it was pointed out that water power is one of Alaska's greatest undeveloped resources. When the Eklutna power development is completed it will more than double the present installed water power capacity in Alaska. It was reported that the U.S. Geological Survey has a program of water power investigations the objective of which is to arrive at a complete inventory of the water power potential of the territory. Construction problems peculiar to Alaska were pointed out by the papers "Engineering geology of a segment of the Denali Highway, Alaska," "Transportation in Alaska and the far northwest," "Subarctic highway construction and maintenance," and "Construction of Icy Bay airfield." Other engineering papers were "Rubber deterioration by ozone," "Mass-transfer coefficient for a flowing fluid in a packed column," "Construction materials investigations in the railroad belt," and "Cold water thawing."

The outstanding social event of the conference was an all-Alaskan banquet at which all the foods served, except condiments, coffee, and a few minor items, were products of Alaska.

Retiring officers of the Alaska Division are: president, Hugh A. Johnson; vice president, E. K. Day; executive secretary, Troy L. Péwé; and assistant treasurer, Galen Smith. The officers elected for 1954–55 were: president, Neil W. Hosley; vice president, John A. Dassow; secretary, Arthur S. Buswell; treasurer, Galen Smith; and councilor to the national AAAS, Troy L. Péwé. The 6th Alaskan Science Conference is scheduled to be held at the University of Alaska 1–4 June 1955.

TROY L. PÉWÉ

College, Alaska

Science News

The **President's proposed budget** for the National Institutes of Health is $6,399,000, $1.75 million more than was provided for fiscal 1955. A comparison of the two budgets follows: National Cancer Institute, $22,328,000 proposed, $21,737,000 current; Mental Health Institute, $17,501,000 proposed, $14,147,500 current; National Heart Institute, $17,278,000 proposed, $16,668,000 current; Dental Health Institute, $2,136,000 proposed, $1,990,000 current; Institute of Arthritis and Metabolic Diseases, $8,740,000 proposed, $8,740,000 current; Microbiological Institute, $6,645,000 proposed, $6,180,000 current; Institute for Neurological Diseases and Blindness, $8,111,000 proposed, $7,600,500 current.

The new budget for the Atomic Energy Commission is $2 billion, a reduction of approximately $50 million. The President said that the amount "provides for greater expenditures than ever before on projects to develop peaceful applications of atomic energy." Tables in the budget message show that the vast proportion of expenses was listed in the category of "major national security"—approximately $1.91 billion. Presumably this includes items for production of raw material and for development that could be used either for weapons or for peaceful purposes.

A joint expedition of Egypt's Department of Antiquities and the University Museum of the University of Pennsylvania will soon begin excavating a long-buried part of the temple of the great god Ptah at Memphis, capital of ancient Egypt, according to Froelich G. Rainey, director of the museum. Representing the museum on its first **Egyptian expedition** in 23 yr are John M. Dimick, project director; Rudolf Anthes, curator of the Egyptian section, and Henry G. Fischer, assistant curator. The new excavation site was accidentally discovered by roadbuilders shortly after World War II. This will be the first extensive scientific search of the area.

Discovery that cancer patients have too little of a **blood substance called "Q"** has been announced by Allen F. Reid, biophysicist, and his associates at Southwestern Medical School of the University of Texas, Dallas. "Q," so far not otherwise identified, acts "as a brake on the transport of stored energy from one part of the body to another." Because of a "Q" deficiency, "vital energy is transported at reckless rates and spent lavishly on the building and operation of useless cancer cells." It has not yet been possible to isolate enough "Q" to determine whether or not it might have any effect as a treatment for cancer. The research for this discovery was supported by the American Cancer Society.

What is thought to be the largest prefabricated building ever erected in Antarctica and "the most complex structure for scientific purposes ever to be taken by an expedition," is being established by an Australian group based at **Mawson Harbor in MacRobertson Land** on the Indian Ocean coast. Oustide temperatures may fall to −40°F, but the inside temperature will be maintained at 60°F. The building, which holds a physics laboratory and is 37 ft long, 15 ft wide, and 10½ ft high, has been designed to withstand winds of up to 200 mi/hr. Apparatus for measuring the intensity of cosmic radiation will be the principal equipment in the laboratory. The research is being carried out in cooperation with the University of Tasmania. The senior physicist, F. Jacka of Melbourne, designed the new building.

"Radiocarbon dating" is discussed by H. Barker of the Research Laboratory, British Museum, London, in the Techniques of Research series in the London *Times* Science Review (Winter 1954). Barker describes some of the problems involved in radiocarbon dating, for example the small quantities of carbon-14 in samples, the reduction of the background count, the limits of detection, and the accuracy and statistical interpretation of the results. In addition, he compares some aspects of the solid-sample method of counting with the more recent gas counting techniques that use either carbon dioxide or acetylene, and suggests that scintillation counting may extend the limit of counting and increase the statistical accuracy of radiocarbon dating in the future.

A Federal Trade Commission hearing examiner has **refused to receive in evidence** a report of a committee of the National Academy of Sciences supporting the view of the National Bureau of Standards that AD-X2, controversial automobile battery additive, was worthless. The examiner said that he could not find any portion of the report that was so segregated that it would apply only to the 11 tests made by the Bureau of Standards that are in evidence.

America's farm surpluses, which now cost the nation $256 million/yr in storage bills, could be brought to all the hungry peoples outside the iron curtain for a cost of 5 ct/day for each person given full feedings. If used to add 500 cal/day to the food supplies of the many peoples whose diets are deficient by that amount, the cost would be 2 ct/person or less. These figures are included in a survey issued by CARE, which is urging a food crusade to distribute U.S. surpluses abroad.

In mid-January the Atomic Energy Commission and its laboratory directors held a 2-day review of **employee security procedures** and found them generally "excellent." Participants in the closed meetings were from the Los Alamos Scientific Laboratory, N.M.; National Reactor Testing Station, Idaho; Brookhaven National Laboratory, Upton, N.Y.; Oak Ridge Laboratory, Tenn.; Sandia Laboratory, N.M.; Ames Laboratory, Iowa; and the Argonne National Laboratory, Lemont, Ill. Lewis L. Strauss, chairman of the AEC, said:

> It was the concensus that the over-all operation of security clearance procedures was excellent. They [the participants] expressed the belief that improvements and clarifications should be achieved in some minor aspects, and suggested further study to this end. Their recommendations are being taken under consideration by the commission.

A study carried out by Robert J. Bolt, Charles J. Tupper, H. Marvin Pollard, and O. Tod Mallery of the University of Michigan's Medical School and Institute of Industrial Health has revealed that of 500 **business executives examined** at the University Hospital, 41 percent possessed abnormalities that they did not know existed and that required medical treatment. Abnormalities not demanding immediate attention were found in 25 percent of the executives. The survey was conducted on a group of 500 apparently healthy individuals undergoing periodic health check-ups.

The greatest number of individuals was found to have gastrointestinal disturbances (45 percent). This was followed by cardiovascular disease (24 percent), Third were nose and throat ailments (18 percent). Four cases of previously unknown cancer were found, as well as the following unsuspected conditions: 27 cases of high blood pressure; 16 peptic ulcers; 12 gallstones; 8 organic heart conditions; 3 diabetics; and 1 case of tuberculosis. In follow-ups it was found that "significant new disease appeared each year in 13 to 20 percent of the subjects."

A 2-yr study conducted by Cecil Pierce, an animal husbandman at the Oregon State College eastern branch experiment station in Union, has shown that **shorn lambs fatten faster,** and on less feed, than unshorn lambs. The former gained approximately 17 percent more per day than the latter when both were fed under similar conditions.

The seven-nation scientific committee representing the United States, the Soviet Union, Great Britain, France, Canada, India, and Brazil that met under the auspices of the United Nations to plan a conference on the **peaceful uses of atomic energy** has tentatively agreed that the conference might take place in Geneva beginning 8 Aug.

Scientists in the News

Hubert B. Vickery, chief biochemist at the Connecticut Agricultural Experiment Station, New Haven, has received the annual distinguished service award given jointly by the Cigar Manufacturers Association of America and the Cigar Institute of America. He was honored for "distinguished scientific research of benefit to the cigar industry of the United States" and for "outstanding contributions to the chemistry of the tobacco plant."

John C. Krantz, Jr., professor of pharmacology at the School of Medicine, University of Maryland, will be the third recipient of the Rho Chi citation at the Philadelphia College of Pharmacy and Science on 2 Mar. He will deliver the Julius W. Sturmer memorial lecture, which will be entitled "The simplicity to wonder."

Edward M. Palmquist, chairman of the department of botany at the University of Missouri, has arranged to take a leave of absence to serve as program director for education in the sciences for the National Science Foundation. This program is part of the foundation's over-all program relating to scientific personnel and education. Its objective is to encourage more qualified

young people to seek education and careers in science and to improve the education of those so encouraged. In its effort to achieve these ends the foundation sponsors activities of three kinds, some of which are already in operation, although most are still in the planning stage. One has to do with increasing the competence and effectiveness of high-school and college teachers of science, a second with the improvement of the science curriculum at all levels, and a third with identification and encouragement of able high-school and college students.

I. W. McDonald, a senior principal scientific officer in the Institute of Animal Physiology, Cambridge, England, has been appointed officer-in-charge of the Commonwealth Scientific and Industrial Research Organization's Sheep Biology Laboratory, Prospect, New South Wales, Australia. In 1949 McDonald spent a year at Cornell University, where he conducted research in animal physiology with L. A. Maynard.

Gilbert E. Goheen, formerly director of research and development of the J. T. Baker Chemical Co., has joined the staff of the U.S. Department of Agriculture's Southern Utilization Research Branch, New Orleans, La. He will assist in the planning and direction of the research program of the branch, which comprises the Southern Regional Research Laboratory at New Orleans and six field stations.

James P. Hughes, a practicing physician in Cincinnati, Ohio, who is teaching part time at the University of Cincinnati, has been appointed associate professor of preventive medicine in Ohio State University's College of Medicine. Hughes is one of only seven men in the United States with a doctor's degree in industrial medicine.

William J. Robbins, director of the New York Botanical Garden, left on 16 Jan. to represent the National Academy of Sciences at the seventh annual session of the Pakistan Science Conference and to carry greetings to the recently formed Pakistan Academy of Sciences. He will return in February.

Robert A. Turner, former associate professor of biochemistry at the College of Medicine, State University of New York, has joined the staff of the New England Institute for Medical Research in Ridgefield, Conn., as chief of biochemistry. He has recently visited European universities and research organizations to gather scientific information of interest to the institute.

In January **Igor A. Sikorsky,** aeronautical pioneer, went to London to receive the 1955 James Watt international medal, a top honor in mechanical engineering.

Willis E. Lamb, Jr., professor of physics at Stanford University, has received the 1954 Research Corp. award—a plaque, a citation, and $2500—for his work in nuclear physics.

John Gardner, vice president of the Carnegie Corporation of New York since 1949, has been elected president. He succeeds **Charles Dollard,** who resigned after an association of more than 16 yr.

Sewall Wright, mathematical geneticist whose researches have demonstrated that the pattern of evolution is more complex than it was previously thought to be, has retired from the faculty of the University of Chicago. A member of the faculty since 1926, Wright was distinguished service professor of zoology at the time of his retirement. He is particularly known for his researches on the statistical pattern of heredity. In 1934 he was elected a member of the National Academy of Sciences. He is also an honorary member of the Genetical Society of Great Britain and the Royal Society of Edinburgh and has received numerous awards among which are the Daniel Giraud Elliott medal and prize of the National Academy of Sciences and the Weldon medal and prize of the University of Oxford.

L. Fredric Hough returned to the staff of the department of horticulture at Rutgers University on 1 Jan. after a 3-yr leave of absence during which he fulfilled a Point Four assignment for the U.S. Department of Agriculture in Liberia. The last year of the trip was devoted to traveling through North Africa, the Caucasian area, Lebanon, and Europe, with the primary purpose of meeting fruit breeders and examining germ plasma material. Hough spent the fall of 1954 at Purdue University, where he worked with J. R. Shay on disease-resistance breeding in fruit plants.

David G. White, on sabbatical leave from Pennsylvania State University, served in Hough's capacity from August to February. White taught a new course entitled "Plant science techniques" and also prepared a book manuscript on this subject for publication in the next year.

Henry M. Bickart, associate professor of ornamental horticulture, retired from the department of horticulture, Rutgers University, on 15 Oct. after 37 yr of service in floriculture, propagation, and outdoor flower gardening. On 30 Nov. **Arthur J. Farley,** for 46 yr an extension pomologist for the university, also retired.

Robert C. McMaster, a member of the Battelle Memorial Institute staff since 1945 and a well known "television weatherman," has been appointed professor in the department of welding engineering at Ohio State University.

Ven Te Chow of the University of Illinois has been named chairman of the water runoff committee of the American Geophysical Union. The committee's objective is to stimulate and coordinate research on runoff problems such as surface and subsurface flow from watersheds, river flow, floods, and droughts. Leading engineers and scientists from all parts of the country are members of the committee.

Allen O. Whipple, who was Valentine Mott professor of surgery at the Columbia University College of Physicians and Surgeons for 25 yr, and director of surgery at Presbyterian Hospital for the same period until his retirement in 1946, has received the academy medal of the New York Academy of Medicine. It is awarded at the discretion of the academy's council for distinguished service in medicine and has been awarded only eight times since its endowment by Samuel McCullough in 1928.

The Physical Society of London has elected **D. F. Martyn,** chief scientific officer of the Radio Research Board of the Commonwealth Scientific and Industrial Research Organization, Australia, as Charles Chree medalist for 1955. The award, which may be made to scientists of any country, was given in recognition of Martyn's outstanding researches concerning the ionosphere.

In a reorganization of engineering activities at the Stanford Research Institute, **Jerre D. Noe** has been appointed assistant director of engineering research. Also announced are the appointments of **Byron J. Bennett** as manager of the computer laboratory, and **Kenneth R. Eldredge** as manager of the control systems laboratory. Both newly formed laboratories will be supervised by Noe.

The Joseph Goldberger award for outstanding contributions in the field of medical and public health aspects of nutrition was recently presented to **Russell Morse Wilder** at a meeting of the Food and Nutrition Board of the National Research Council. This annual award, administered by the American Medical Association, is sponsored by the Nutrition Foundation as a stimulus to medical investigators in advancing the frontiers of public and personal health with special reference to the significance of good nutrition.

Alfred Hurwitz, chief of surgery at the Veterans Administration Hospital in West Haven, Conn., and associate clinical professor of surgery at the Yale University School of Medicine, has been named to concurrent posts in Brooklyn as professor of surgery at the State University of New York College of Medicine and as director of surgical services at Maimonides Hospital.

Another appointment at the college is that of **Louis J. Soffer** to the post of clinical professor of medicine, effective 1 Apr. He is now attending physician and head of endocrinology at Mount Sinai Hospital in New York.

John R. Bowman, director of research at the Mellon Institute for Industrial Research, recently received the $1000 Professional Progress award in chemical engineering, sponsored by Celanese Corp. of America, and administered by the American Institute of Chemical Engineers "in recognition of distinguished services to the science and profession of chemical engineering by bringing to it skills of other scientific and mathematical disciplines and by showing how these powerful tools can be put to work in the solution of chemical engineering problems."

Five teachers recently received awards from the committee on school science of the American Academy of Arts and Sciences for outstanding teaching in science and mathematics in the secondary schools of New England. The awards were made from the Elizabeth Thompson Science Fund. Those honored were **Norman W. Lafayette,** chemistry, Hamden High School, Hamden, Conn.; **Wallace W. Sawyer,** physics and chemistry, Weston High School, Weston, Mass.; **Eleanor E. Taylor,** mathematics, Central Junior High School, Quincy, Mass.; **Howard Wagner,** general science, Laconia High School, Laconia, N.H.; **Maurice M. Whitten,** chemistry, physics, and general science, Lewiston High School, Lewiston, Me.

Necrology

English Bagby, 64, professor of psychology at the University of North Carolina, Chapel Hill, 14 Jan.; **Summerfield Baldwin,** 58, head of the Div. of Social Sciences at Akron University, Akron, Ohio, 15 Jan.; **Hubert C. Booth,** 83, consulting engineer and inventor of the vacuum cleaner, London, 14 Jan.; **Alessandro Brizi,** 76, pioneer in modern farming methods, former secretary general of the International Institute of Agriculture, and former Minister of Agriculture, Rome, 16 Jan.; **Brother Defendant Felix,** 67, retired professor and head of the mathematics department at Manhattan College, New York, 15 Jan.; **Henri Gougerot,** 73, authority on venereal diseases, author, and professor of dermatology and syphilology at the University of Paris, Paris, 15 Jan.; **Ferdinand Hochstetter,** 93, authority on human embryology, author, editor, and professor emeritus of anatomy at the University of Vienna, Vienna, 10 Nov.

William M. Jardine, 76, agronomist, author, former Secretary of Agriculture and president of Kansas State Agricultural College at Manhattan and the University of Wichita, Wichita, Kans., 17 Jan.; **Brother Adelphus Joseph,** 64, former professor and head of the chemistry department at Manhattan College, New York, 19 Jan.; **Jacob M. Kinney,** 77, former editor of *School Science and Mathematics* and visiting professor of mathematics at the University of Chicago and Illinois Institute of Technology, Chicago, 19 Jan.; **Jose Lubschez,** biochemist on the research staff of the department of pediatrics of the New York Hospital–Cornell Medical Center, New York, 18 Jan.; **D. Horace Nelson,** 56, author and assistant professor of dairy industries at the University of Massachusetts, Amherst, 14 Jan.; **Lowell S. Selling,** 52, psychiatrist and author, Orlando, Fla., 18 Jan.; **Wilson Zerfing,** 86, retired dentist and instructor in the University of Pennsylvania Dental School, Philadelphia, 13 Jan.

Meetings

The **American Society of Mechanical Engineers** will hold an all-day conference in New York, 16 Feb., during which Vannevar Bush, president of the Carnegie Institution of Washington, will deliver the principal address. The conference has as its theme *The Engineer and the World of Communications.* It will take place on the 75th anniversary of the day on which initial plans were laid for the founding of the society.

The **3rd International Congress of Vitamin E** will be held in Milan, Italy, at the beginning of Sept. Scientists from Italy, America, England, and other European countries will participate. Persons wishing to send communications to the congress must do so *before 1 Mar.* Two summaries not more than one page in length, one of which must be in the English language, should accompany all such communications. These and any requests for further information should be addressed to Prof. Emilio Raverdino, Secretary, Milano, Via Pietro Verri 4.

An **International Symposium on Cardiovascular Surgery** will be held at the Henry Ford Hospital, Detroit, Mich., 17–19 Mar. Diagnostic and operative techniques in cardiovascular diseases will be discussed. Inquiries should be addressed to Dr. John Keyes, Secretary, International Symposium on Cardiovascular Surgery, Henry Ford Hospital, Detroit 2, Mich.

The **spring meeting of the URSI** will be held at the National Bureau of Standards, Washington, D.C., 3–5 May, under the sponsorship of the U.S.A. National Committee of the International Scientific Radio Union. Symposiums tentatively planned include: forward scattering of radio waves, theoretical aspects of ferrites at microwaves, mechanisms and limitations of microwave noise sources, and multimode microwave transmission systems. Authors should submit titles and 100- to 200-word abstracts to the appropriate commission representative or professional group representative *by 1 Mar.* For further information, write William E. Gordon, Secretary, U.S.A. National Committee, URSI, School of Electrical Engineering, Cornell University, Ithaca, N.Y.

The **Tissue Culture Association** will hold its annual meeting on 5 Apr. at Jefferson Medical College, Philadelphia. In addition to the usual presentations, there will be a session devoted to the culture of plant cells. On 6 Apr. the association will hold a joint session with the American Association of Anatomists.

The department of biochemistry and the graduate school of the University of Washington, Seattle, are sponsoring a symposium on the **Molecular Basis of Enzyme Action** to be held on 7–8 Apr. The following addresses will be presented: "Metallo-enzymes," B. L. Vallee, Harvard University; "Transpeptidation reactions," C. S. Hanes, University of Toronto; "Peptides resulting from the action of proteolytic enzymes on purified proteins," W. H. Stein, Rockefeller Institute; "Kinetic determination of ionization constants of enzymes and enzyme-substrate complexes," R. A. Alberty, University of Wisconsin; "Interaction of hormones with enzyme systems," H. A. Lardy, University of Wisconsin; "Biological synthesis of terpenes and steroids," K. Bloch, Harvard University; "Reconstruction of the electron transport system of animal tissues," D. E. Green, University of Wisconsin; and "Enzymatic mechanisms of nucleic acid synthesis," A. Kornberg, Washington University. All inquiries should be addressed to the Department of Biochemistry, University of Washington, Seattle 5.

The **Division of High-Polymer Physics of the American Physical Society** will hold its 13th meeting at Baltimore, Md., 17–19 Mar., jointly with a meeting of the parent society. The program was arranged by a committee headed by Thomas DeWitt, Mellon Institute, and includes a symposium on physical investigations of nucleic acid.

The **2nd International Congress of Allergology** will be held, by invitation of the Brazilian Allergy Society, in Rio de Janeiro, 6–13 Nov. F. W. Wittich, president of the International Association of Allergology, will act as chairman. The official languages will be English, French, Portuguese, and Spanish; the chief topics will be presented in these languages. North Americans wishing to present papers should send their requests to Dr. F. W. Wittich, 424 LaSalle Medical Building, Minneapolis 2, Minn. Other information about the congress can be obtained from Dr. B. N. Halpern, Secretary, 197 Boulevard Saint Germain, Paris VII°.

The Medical School of the University of Wisconsin, Madison, is sponsoring a symposium on **Metabolic Aspects of Transport across Cell Membranes,** 29–31 Aug. The program will include speakers from this country and abroad, and several round-table discussions. Reservations and further information can be obtained from the Symposium Committee, Dept. of Pharmacology, Service Memorial Institutes, University of Wisconsin, Madison.

An **International Congress on Catalysis** will be held in Philadelphia, 10–14 Sept. 1956. It will be sponsored jointly by the National Science Foundation, the Catalysis Club of Philadelphia, the Catalysis Club of Chicago, and the University of Pennsylvania. This will be the first international meeting on catalysis to be held in America and will cover heterogeneous as well as subjects of homogeneous and biocatalysis. All papers presented at the meeting will be preprinted to facilitate discussion.

The National Science Foundation has given a grant to the sponsors of the congress to enable them to offer some financial support to scientists who could not otherwise attend the meeting. Additional funds are

being raised by subscription. Hugh S. Taylor, Eugene J. Houdry, and Eric Rideal have been named honorary chairmen of the congress. A. Farkas is in charge of program arrangements. All inquiries concerning this meeting and its organization should be directed to Dr. H. Heinemann, Executive Secretary of the International Congress on Catalysis, c/o Houdry Process Corp., P.O. Box 427, Marcus Hook, Pa.

A **Nuclear Congress and Atomic Exposition** will be held 12–17 Dec. in Cleveland, Ohio, under the leadership of the Engineers Joint Council and a dozen organizations representing more than 250,000 American scientists, engineers, and industrialists. The basic objective of the congress is to launch a continuing program of interchange of information on the development of applications of nuclear science. Further information may be obtained from the Engineers Joint Council, 29 W. 39 St., New York 18.

Education

A **radar set designed specifically for meteorologic purposes** has been installed at Harvard University's Blue Hills Observatory on Great Blue Hill, Milton, Mass. Meteorologists will use the radar to determine the size, intensity, and sometimes the velocity of weather disturbances at ranges up to 300 mi. The radar, which will be used for research purposes, is capable of determining the heights of a cloud top, base, and freezing level; it will also be used to study particles of precipitation and to map regions of up- and downdraft in thunderstorms. The installation consists of an 8-ft rotating antenna on a 50-ft tower and a console mounted in a Jamesway hut. The console has four indicators, an A-type to show signal intensity compared with range, a range-height indicator to present the vertical cross section of a storm, and two plan position indicators. The radar will be operated by Blue Hills Observatory under a contract with the Air Force Cambridge Research Center; the information obtained will be studied by workers at the Atmospheric Physics Laboratory of the Geophysics Research Directorate, Air Force Cambridge Research Center.

An **introduction to the basic medical sciences** treated in an advanced fashion and from a research point of view is being offered in Harvard Medical School. It includes experimental methods and fundamental principles associated with each subject, and replaces a full year of formal course work, although it does not cover all topics usually assigned to each of the participating sciences. Members of a group planning research in several different fields have the opportunity to work together for a year in this "home laboratory." Each may then enter a special course to carry out advanced studies and thesis work.

The teaching staff for this special program consists of instructors drawn from each of the basic preclinical departments. The physical center of the course is a special laboratory built to accommodate 20 students, each of whom is allotted a chemical bench, combination writing desk and microscope table, and bookshelf. The open area of the room is used for experiments requiring heavy equipment.

The idea of presenting selected areas of study with thoroughness and emphasizing their nature as models rather than with the encyclopedic approach has proved a fruitful way of teaching. Because of regular post-lecture discussions the students have developed ability to present concise accounts of experiments. The new plan is described by Manfred L. Karnovsky, assistant professor of biological chemistry, in the January issue of the *Journal of Medical Education*.

The American Chemical Society's New York section has announced that a series of discussions on ***Separation Techniques in Chemistry*** will take place on Wednesday evenings, beginning 23 Feb., in the Union Carbide and Carbon Corp. building, 30 E. 42 St. Applications for enrollment in the course should be sent promptly to Mr. John J. Miskel, Charles Pfizer and Co., 11 Bartlett St., Brooklyn 6, N.Y.

Available Fellowships and Awards

The **Harvard University School of Public Health** has announced the availability of scholarships for 1955–56. These will be granted to individuals of high professional promise in awards ranging from part tuition to tuition and stipend, according to the qualifications and financial needs of the applicants. The scholarship funds are limited and are primarily intended for citizens of the United States. The application *deadline is 1 Mar.* For information, write the Secretary, Harvard School of Public Health, 55 Shattuck St., Boston 15, Mass.

The **Special Libraries Association** has announced the availability of a $1000 graduate scholarship. The award is intended only for those in need of financial assistance to complete the professional education necessary for work in the special library field. Information may be obtained from the Executive Secretary, Special Libraries Association, 31 E. 10th St., New York 3. *Applications must be received by 1 Mar.*

Members of **Tau Beta Pi** are invited to apply for the society's annual $1200 fellowships for graduate study in engineering during 1955–56. *Applications must be received by 28 Feb.* For information, write Paul H. Robbins, 1121 15th St. NW, Washington 5, D.C.

The **National Council to Combat Blindness, Inc.**, has announced that it is welcoming applications for its 1955–56 research awards for grants-in-aid and full-time research fellowships in ophthalmology and its related sciences. The council has added to its research program the financing of summer fellowships initiated by its Scientific Advisory Committee to encourage

ophthalmic investigations. All applicants for fellowships, full-time or summer, are required to make their own arrangements for suitable research facilities with accredited institutions. The closing date for the receipt of completed applications *is 15 Apr.* Forms may be obtained by addressing: Secretary, National Council to Combat Blindness, Inc., 30 Central Park So., New York 19.

The **Nature Conservancy** is offering a $500 scholarship for graduate study in conservation-human population relationships during 1955–56. Any candidate for an advanced degree may apply provided that his chosen thesis subject includes as a major concern some aspect of the relationship between natural area preservation and the increasing pressure of human population.

An applicant should submit a brief outline of his proposed thesis. In addition he should submit relevant information about himself and addresses of several references, including the professor under whom he is studying. *Application should be made by 1 Apr.* to the Nature Conservancy, 4200 22nd St. NE, Washington 18, D.C.

The **Medical Library Association** is offering four scholarships of $150 each for summer school courses in medical library work in 1955, two at Columbia University and two at Emory University. Applications for these scholarships should be made to the school at the time of application for enrollment. The association's *closing date for applications is 1 Apr.*, and candidates must already have been accepted by the school. Completion of either course will enable a student with a bachelor's degree and 1 yr of library school training to qualify for grade I certification by the Medical Library Association.

The course at Columbia, which is on the medical library, is offered 5 July–12 Aug. It will be given by Thomas P. Fleming, librarian of the College of Physicians and Surgeons. Tuition is $75; registration, $10. For further information write to The Dean, School of Library Service, Columbia University, New York 27, N.Y.

Emory University offers a course in medical libraries 18 July–20 Aug., and the instructor is Mildred Jordan, librarian of the Calhoun Medical Library, Emory University Medical School. Tuition is $60; matriculation, $5. For information write to The Director, Division of Librarianship of Emory University, Emory University, Ga.

The department of anatomy, **University of Washington,** announces the availability of graduate assistantships for Ph.D. candidates. In addition to the conventional special division of anatomy, the department sponsors research and advanced training in submicroscopic anatomy, electron microscopy, cytochemistry, x-ray diffraction, microspectroscopy, and tracer biology. For information write: Executive Officer, Department of Anatomy, University of Washington, Seattle 5, Wash.

Miscellaneous

Weather or Not, a new educational motion picture that shows how farm profits can be increased by fertilization and irrigation, is now available for distribution by the National Fertilizer Association. This 16-mm sound-color movie, which runs 21.5 min, is the second educational picture produced by N.F.A. during 1954. The other, *The Big Test,* which describes the approved method of taking soil samples to be used in determining plant food deficiencies in the soil, was released in December. Both pictures were produced by N.F.A.'s Robert H. Engle. Cooperating in the production of *Weather or Not* was the Sprinkler Irrigation Association. The advisory committee on the film included representatives of the American Society for Horticultural Science, the American Society of Agricultural Engineers, and the American Society of Agronomy.

All N.F.A. movies may be borrowed free of charge by sending a request to the association at 616 Investment Building, Washington 5, D.C. Persons or groups wishing permanent copies of films may arrange to purchase them at cost.

The U.S. Civil Service Commission has announced a new examination for **bacteriologist, biochemist, and serologist positions** in hospitals and regional offices of the Veterans Administration throughout the United States and Puerto Rico. The salaries range from $4205 to $8360/yr.

No written test is required. Applicants must have had appropriate education and experience. Graduate study may be substituted for the experience required for the lower salaried positions, and for part of that required for the higher salaried positions. Full information regarding the requirements and how to apply may be secured at many post offices throughout the country, or from the U.S. Civil Service Commission, Washington 25, D.C.

The Atomic Industrial Forum, Inc., 260 Madison Ave., has published *The New Atomic Energy Law—What It Means to Industry.* The $5 volume constitutes the proceedings of a meeting in New York, 27–28 Sept., at which top authorities from industry and government presented the first comprehensive analysis of the Atomic Energy Act of 1954. Each major aspect of the new law was represented on the program. In addition to a basic interpretation of the Act, the proceedings include separate sections on investment problems and opportunities, what industry sees ahead, the new industry-government partnership, government implementation of the new law, the labor outlook, and insurance problems. Further, the material is presented at a technical level that will make it of interest to both management and research people.

Erratum: In the 10 Sept. 1954 issue the amount of the American Library Association's Oberly Memorial award was incorrectly given as $1200. Actually, the award consists of income—interest for 2 yr—from a fund of about $1200. We regret this error and are glad to make correction.

Book Reviews

X-Ray Diffraction Procedures. For polycrystalline and amorphous materials. Harold P. Klug and Leroy E. Alexander. Wiley, New York; Chapman & Hall, London, 1954. xiii + 716 pp. Illus. $15.

In their preface, the authors point out the need for a comprehensive treatise on the practice and interpretation of x-ray diffraction techniques, designed to "serve as both manual and teacher for the plant worker, the graduate student, the research scientist, and others who wish to do experimental work in the field." In general, they have done a meritorious job in filling this need, and have succeeded in turning out a comprehensive handbook on powder diffraction procedures.

The first 160 pages are devoted to a discussion, in simple terms, of the basic concepts of crystallography, x-rays, and diffraction. The remaining 520 pages are devoted to the practical aspects of obtaining and interpreting powder diffraction information. Single crystal techniques are not discussed. There are sections on small-angle scattering and scattering from noncrystalline material; useful tables are listed in the appendixes, together with instructions for laying out an x-ray laboratory and for handling film. The authors discuss in detail the various types of powder cameras (70 pp.) and the Geiger-counter spectrometer (80 pp.). It is my opinion that too much emphasis has been placed on spectrometer techniques. Thus, although Klug and Alexander say that "focusing cameras are not an indispensable adjunct to a diversified diffraction laboratory"—certainly a fair statement—no such remark is made concerning the Geiger-counter spectrometer which, in view of its cost and lack of versatility, is even less indispensable.

The sections concerning the techniques of preparing and analyzing specimens are complete to the most trivial detail, and include designs for light boxes, measuring scales, and camera supports. On page 302, where a method of preparing a powder sample for spectrometer analysis is described (with complete illustrations), we are told that Scotch tape may be removed more easily if a tip of the tape has been doubled back, and are also told to trim off excess tape with scissors. This sort of trivia abounds throughout the book, and may indeed be welcomed by many novice laboratory technicians. However, a majority of readers who must pay $15 for the book will probably feel that a substantial saving could have been realized by judicious condensing and editing.

In view of the thoroughness with which the authors discuss the various experimental techniques, it is unfortunate that the material concerning the interpretation of the data—and, in particular, the precision determination of lattice constants—has been presented in a rather offhand fashion. Indeed, much of the material in this particular section is misleading. The least-squares method of refining lattice parameters is discussed with the apology that "it assigns equal weight to all reflections regardless of whether they can be measured with good or poor accuracy." This statement is particularly unfortunate since the very essence of a least-squares treatment is that it allows and, in fact, requires that observations be weighted in accordance with their uncertainties. In particular, the uncertainty in the observed value of sin θ for a particular powder reflection is, to the first approximation, proportional to cos θ. Thus, in the back reflection region the weighting becomes an extremely important consideration. The authors are also negligent in their discussion of probable errors. Thus, on page 487 data from GeO_2 is analyzed to yield best values for lattice parameters. This analysis is followed by the statement: "The precision in a_0 is of the order of ± 0.0002 A." It is unfortunate that Klug and Alexander have not seized upon their opportunity to resolve the confusion in the minds of many, many workers concerning the meaning and methods of evaluating uncertainties.

On the whole, the authors should be complimented on their results. The book should provide easy, informative reading for a large body of untrained technicians, as well as form a convenient reference for all workers in the field of powder diffraction. It is pleasing to find, under one cover, such diverse topics as the radial distribution treatment of diffraction data, determination of crystallite size, and a discussion of refraction effects. The figures and printing are good, and references are abundant. The price is high.

RICHARD E. MARSH

Chemistry Department,
California Institute of Technology

Evolution as a Process. Julian Huxley, A. C. Hardy, and E. B. Ford, Eds. Macmillan, New York; Allen & Unwin, London, 1954. 367 pp. Illus. $4.25.

Although the first centenary of Darwin's *The Origin of Species* is less than 5 years distant, the problem of evolution has again become the focus of theoretical (or shall one say, philosophic) biology. A symposium on evolution, held under the auspices of the British Society of Experimental Biology and the Genetical Society, was published in 1953 [reviewed in *Science*, **119**, 156 (1954)]. The symposium now under review has been organized by friends of Julian Huxley and dedicated to him on the occasion of his sixty-fifth birthday. Only three of the 19 contributors also participated in the first symposium.

The symposium covers a wide range of topics. Phylogeny building is represented by G. R. de Beer (discussing Hadzi's theory of the origin of Metazoa), A. C. Hardy (origin of the chordates), E. J. H. Corner (origin of the tropical rainforest flora), and J. Zuckerman (phylogeny of the primates, the Aus-

tralopithecines being regarded as a branch remote from human ancestry). The effects of natural selection on race formation are discussed by E. B. Ford (in Lepidoptera), P. M. Sheppard (snails, moths, Drosophila), D. Lack (variations in fecundity in races of birds), H. N. Southern (mimicry in cuckoos), and E. Mayr (continental and island races in birds). The evolution of behavior, primarily in birds, is dealt with by J. Fisher, N. Tinbergen, and H. B. Cott; B. Rensch considers the relations between body size, brain structure, learning ability, and behavior in mammals and other vertebrates. The bearing on evolutionary problems of certain aspects of sensory physiology is considered by E. N. Willmer, J. Z. Young, and B. Rensch. J. B. S. Haldane and E. Mayr examine the properties of some genetic population structures. R. A. Fisher comments on the history of the theory of natural selection. The lone paleontologist, T. S. Westall, considers the correlations (or the lack thereof) between the periods of intense mountain building and biological evolution.

It is impossible in a review to do justice to the wealth of ideas discussed in the symposium. One of the controversial issues to which considerable space is devoted concerns the role in evolution of random changes in gene frequencies, referred to as the genetic drift or Sewall Wright's effect. In his excellent paper, Sheppard presents evidence that variations in seemingly indifferent characters, such as the coloration of shells in certain snails, have considerable adaptive significance and are subject to strong selection. But he concludes that: "Thus Wright's concept of drift, though frequently invoked as an important agent in evolution, must be judged of negligible significance as compared to selection." Now, this is a wrong way to state the problem. Genetic drift is not an alternative to selection; its importance lies precisely in its interaction with selection and other directive agents of gene frequency change. The futility of much evolutionary speculation in the past resulted from attempts to picture evolution as caused by some one agent—by mutation, or selection, or hybridization, and so forth. Perhaps the most important advance in the evolutionary thought was the realization that it is the coaction of many agents that brings about evolutionary changes. What kind of change occurs in a population depends on the magnitudes of all the "forces" impinging upon it, as well as on the genetic structure of the population determined by its previous history. Haldane is certainly right when he insists on this quantitative approach to the study of population structure and evolution.

How important may be random changes in gene frequencies is shown by Mayr, who points out that widespread, common, and polymorphic species which inhabit continental areas are usually conservative in the evolutionary sense. And yet geographically peripheral populations of such species, isolated on small islands or by other means, often show striking divergence from the main body of the species, forming clear-cut races or derived species. Mayr ascribes the relative conservatism of continental populations to continuous migration of genes throughout the distribution range, which maintains a high degree of coadaptation of the components of their gene pools. The situation changes when a small number of individuals, perhaps a single pair, forms an isolated colony. The foundation stock of such a colony will almost always contain only a fraction of the genetic variability present in the parental population. This will necessitate a reintegration of the gene pool to arrive at a new adaptively coherent genetic system. An isolated population may thus give rise to a new species, even though it inhabits an environment which is not greatly different from that in which the original population lives. But it may also enter a new ecological niche, and thus produce a novel adaptive type. It would be interesting to examine from Mayr's point of view the remarkable island races of some British butterflies described by E. B. Ford in the same symposium. The origin of these races is not convincingly accounted for either by selection alone or by genetic drift alone, but it may be due to interaction of these factors in populations in which migration of genes is limited or excluded.

THEODOSIUS DOBZHANSKY
Department of Zoology, Columbia University

Gas Dynamics of Thin Bodies. F. I. Frankl and E. A. Karpovich. Trans. from the Russian by M. D. Friedman. Interscience, New York–London, 1954. viii + 175 pp. Illus. $5.75.

The subject of this slender monograph is of interest to some aeronautical engineers but is unlikely to attract mathematicians or physicists. The basic equations of the theory of ideal fluids are linearized, and thereafter follow various further assumed simplifications. The method is well known; the purpose of this monograph is to present the minute details in certain special cases of aeronautical interest.

The work is typical of much now published in Russia. Hastily thrown together in a miserable ragged style, without any attempt to survey the entire literature of the subject, it presents recent Russian methods not easily available otherwise and serves as a unique handbook for those whose particular field is its subject. It is pointless to criticize the details: each person will esteem this book much as he does other recent Russian monographs, according to his personal tastes.

The topics include motion of an elongated body of revolution at subsonic or supersonic speed, accelerated motion, the theory of thin or thick wings of infinite or finite span, unsteady motion of wings and the theory of propellers, and conical flow and its generalizations. Each of these has various special cases which can be combined in many ways: symmetric or unsymmetric bodies, zero or non-zero angle of attack, and so forth. Among the names mentioned are Chaplygin, Prandtl, Busemann, Ackeret, Sedov, Smirnov, Sobolev, Christianovich, Krasilshchikova (here the

translator adds Evvard), Falkovich, Puckett, Khaskind, Frankl, Gurevich, Karpovich, and Hayes. The work is dense with calculations, but the mathematics is simple and within reach of the aeronautical engineer. The "approximations" are heuristic and formal, there is no trace of what a mathematician would regard as a precise theory. The authors make no mention of the extensive literature arguing in favor of retaining terms they throw away or of throwing away terms they retain, as is usual among perturbationists. Thus they give the linearized theory an appearance of finality which would be destroyed by any more catholic presentation of the field.

The translator tells us he has made a literal translation, "with no effort . . . to impose the translator's style on the author's intentions." However, he has added at least one reference (to himself) and one plate without any special notice; what else he may have changed we can only guess. In some places he appears to preserve the Russian word order, and surely we cannot blame the author for "make $\partial\phi/\partial t$ to vanish" (p. 5), "the formula for the pressure is derived, now" (pp. 6–7), "to show that the wave equations, is satisfied" (pp. 11–12), "the body generatrices" (p. 22), and so forth, not to mention the many misspellings.

C. TRUESDELL

Graduate Institute for Mathematics and Mechanics, Indiana University

Protein Metabolism. R. B. Fisher. Methuen, London; Wiley, New York, 1954. ix + 198 pp. Illus. $2.50.

This interesting and thoughtfully written little book is the latest member of the excellent series known as *Methuen's Monographs on Biochemical Subjects.* Like its predecessors, it is pocket-sized and very convenient to carry about for perusal at odd times.

It is the stated purpose of the author to "re-view" the essential knowledge of protein metabolism and to remind the reader of the possibility of reinterpreting discovered facts in the light of later findings. He is interested in redirecting the student to some of the older literature and is opposed to the rather popular notion that what is latest is always best.

There are seven essays, all but one accompanied by a conclusion. There is a general conclusion at the end of the book. The essays are: I, "Digestion and absorption of protein"; II, "The overall picture of protein metabolism"; III, "The metabolic significance of specific enzymes"; IV, "General aspects of the metabolism of the amino acids"; V, "The use of isotopes in the study of protein metabolism"; VI, "Metabolic and endocrine interactions in protein metabolism"; and VII, "The nutritive value of proteins." In each case the author undertakes to question current hypotheses, particularly in those cases where the physiological point of view seems to have been lost sight of or neglected. His central theme is that protein metabolism must be considered to be the metabolism of the amino acids in concert and that, of the variety of chemical and physiological factors which are kept in balance, no one can be neglected indefinitely.

Among the questions raised are included the examples that follow. It is my opinion that reappraisals which are the heart of this small volume may well stimulate future studies. Fisher, who is demonstrator in biochemistry, University of Oxford, considers that it is not firmly established that the "currency" of protein metabolism is amino acids. There is a distinct possibility that small peptides may fulfill such a role. There is no complete assurance that amino acids only are the end products of digestive proteolysis. The time required for complete digestion of proteins by protease action *in vitro* seems to be at variance with any assumption of complete hydrolysis.

It is the author's view that protein synthesis involves not only competition for precursors but also secondary physiologic influences which affect the synthetic process. In the light of present data, transamination, deamination, and the urea cycle seem to be somewhat lacking insofar as detailed knowledge of protein catabolism is concerned. The author is quite skeptical of experiments which have involved feeding a high level of a single amino acid along with an already adequate protein intake. He feels that studies with isotopically labeled amino acids have led to real advances in understanding in spite of certain difficulties of interpretation.

This book is to be recommended as a stimulating and brief analysis of a very complex active research area.

CARL S. VESTLING

Department of Chemistry and Chemical Engineering, University of Illinois

Structure Reports for 1950. vol. 13. A. J. C. Wilson, Gen. Ed.; N. C. Baenziger (Metals), J. M. Bijvoet (Inorganic compounds), and J. Monteath Robertson (Organic compounds), Section eds. Oosthoek. Utrecht, Holland, 1954. (For the International Union of Crystallography. viii + 643 pp. Illus. $21.50.

This is the fourth volume of the series to be published, and it is the latest step in the process of catching up with publications of structural interest during the period since the last issue of the *Strukturbericht*, vol. VII for 1939. Like most workers concerned with structural studies, I turn to each of these reports as they appear to see not only what articles of importance I may have overlooked but also whether I have fully appreciated all important points in the articles I have supposedly read. For these are not abstracts in the ordinary sense; they aim to survey structural work so fully that nothing further would be gained by consulting the original papers. Indeed, these reports may go even further, for the abstractors sometimes give their own comments on the work. For example, their own calculations of interatomic separations may be compared with those in the literature. This is a wonderful service for all structure analysts, and one wonders whether the editors and their col-

laborators will be able to maintain this high level of performance year after year. However, in this fourth volume, the original standard is fully maintained.

All libraries carrying scientific books must have at least one set of this series. Individual crystallographers will also want to possess their own copies, and if *Structure Reports* would catch up a little more rapidly with current work, they might seriously contemplate canceling numerous subscriptions to journals and societies and rely on the reports. Unfortunately, the cost seems to be rising to a level at which few individuals will buy their own copies. Now that the series is getting well past the period of World War II, the amount of work to be summarized is likely to require larger and still more expensive volumes. One may hazard the guess that relatively few individuals in the United States will purchase these volumes at $21.50 each, and in most other countries the cost will probably appear even more prohibitive. Can the cost of future volumes be kept down to a level at which individual workers will feel able to buy them? The increased sales might then offset the lower cost per volume.

I have no intention of proving my diligence by seeking out a few errors. The sections of particular interest to me have been extremely well done, and there are no reasons for supposing that other sections are less well treated. I record with gratitude my indebtedness to the editors and their assistants for the valuable work they are doing, and I look forward to the appearance of further volumes.

G. W. BRINDLEY

School of Mineral Industries,
Pennsylvania State University

Comparative Anatomy of the Vertebrates. George C. Kent, Jr. Blakiston (McGraw-Hill), New York, 1954. xii + 530 pp. Illus. $6.

Several decades ago textbooks in comparative anatomy were almost nonexistent. The solid if stolid old Kingsley volume was breathing its last, and Miss Hyman's present excellent textbook was then merely a laboratory manual, although containing good, if brief, general discussions. In recent years this seeming sterility has changed to fecundity. No less than a dozen writers (I am one of the culprits) have spawned textbooks in the field. These volumes vary considerably in length and style of treatment, according to the desires and interests of their authors, and one or another among them will in general satisfy the needs of an instructor in a course of any type. Kent's work is the newest member of the family.

The book is relatively short (530 pp.) and is definitely designed for a one-semester course. Many of the illustrations are reproduced (as the author notes in his introduction) from the Kingsley book, and it is a pleasure to see these old but reliable friends again in modern surroundings. The treatment follows a familiar pattern. Introductory chapters treat of vertebrate characteristics, funish an account of lower chordates and of the various vertebrate groups, and give a brief introduction to embryology (94 pp.). The remaining 400 pages give, seriatim, an account of the various organ systems. Like the present reviewer, Kent is fond of bones, and devotes 30 percent of his space to the skeleton. May I warn you, Sir, that because of this you are going to receive complaints from people whose tastes run more to viscera than to osteology. I've received plenty of them myself, although devoting a rather smaller percentage of text to the skeleton.

All in all, this is a compact, well-written, and well-illustrated account of vertebrate anatomy which should find a useful place in the family of textbooks in the field. Welcome, brother!

ALFRED S. ROMER

Museum of Comparative Zoology,
Harvard University

Reviews of Research on Problems of Utilization of Saline Water. Arid Zone Programme, No. IV. UNESCO, Paris, 1954. (Order from Columbia University Press, New York.) 96 pp. Illus. Paper, $1.75.

This collection of three papers is the fourth in a series under UNESCO's Arid Zone Programme which since 1951 has been dealing with the various problems of arid regions. The bulletin reviews research in two aspects of saline water, that is, the use of saline water for irrigation, and methods for converting saline water into fresh water.

The agricultural problems resulting from the use of saline waters for irrigation are discussed by two competent authorities. Research in Europe, Africa, and the Middle East is covered by Georges Grillot, head of the Service de la Recherche Agronomique in Morocco. His paper is entitled "The biological and agricultural problems presented by plants tolerant of saline or brackish water and the employment of such water for irrigation." Work carried out in the Americas, Australia, and India is reviewed by H. E. Hayward, director of the U.S. Salinity Laboratory, Riverside, California, in "Plant growth under saline conditions." These two papers summarize a vast amount of knowledge on the effects of various salts on plant life, and on the specific water quality requirements of certain plants.

In a paper entitled "Utilization of sea water," Everett D. Howe, associate dean of the Faculty of Engineering, University of California, very ably reviews the published results of research on methods for the purification of saline water.

Each of these reviews is a thoughtful and intelligent reporting on a specific aspect of the application of saline water to man's requirements. All persons interested in this subject will find here much informative data and constructive opinions. Of particular interest and value are the well selected and organized bibliographies prepared by the three authors.

SHEPPARD T. POWELL

Baltimore, Maryland

Books Reviewed in THE SCIENTIFIC MONTHLY

February

Advances in Genetics, vol. IV, M. Demerec, Ed. (Academic Press). Reviewed by K. C. Atwood.

Tomorrow Is Already Here, R. Jungk (Simon & Schuster). Reviewed by Conway Zirkle.

Minerals for Atomic Energy, R. D. Nininger (Van Nostrand). Reviewed by G. W. Brindley.

America's Resources of Specialized Talent. Report of the Commission on Human Resources and Advanced Training; Dael Wolfle, director (Harper). Reviewed by Ralph W. Tyler.

The Causes and Treatment of Backwardness, C. Burt (Philosophical Library). Reviewed by Karl F. Heiser.

The First Australians, R. M. Berndt and Catherine H. Berndt (Philosophical Library). Reviewed by C. W. M. Hart.

Geographical Essays, W. M. Davis; D. W. Johnson, Ed. (Dover). Reviewed by William A. Hance.

The Giant Cactus Forest and Its World, P. G. Howe Duell, Sloan, and Pearce; Little, Brown). Reviewed by Mortimer L. Bloom.

General College Chemistry, A. J. Scarlett and J. Gómez-Ibáñez (Holt). Reviewed by John A. Timm.

The Anatomy of the Migratory Locust, F. O. Albrecht (Athlone; de Graff). Reviewed by Neal A. Weber.

Ancient History of Western Asia, India and Crete B. Hrozný (Philosophical Library). Reviewed by Francis L. K. Hsu.

Irrigated Soils, D. W. Thorne and H. B. Peterson (Blakiston, ed. 2). Reviewed by Firman E. Bear.

Narcotics and Narcotic Addiction, D. W. Maurer and V. H. Vogel (Thomas). Reviewed by Jerome L. Leon.

Fluoridation as a Public Health Measure, J. H. Shaw, Ed. (AAAS). Reviewed by J. F. Volker.

Student Personnel Work as Deeper Teaching, E. Lloyd-Jones and M. R. Smith, Eds. (Harper). Reviewed by Louise Price.

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Technical Papers

Nitrate Reduction by Certain Strains of *Lactobacillus plantarum**

R. N. Costilow and T. W. Humphreys†
Department of Bacteriology and Public Health, Michigan State College

During a taxonomic study of lactic acid bacteria from cucumber fermentations conducted in this laboratory, it was noted that certain isolates of acid-forming bacteria were able to reduce nitrate. These cultures were found to be similar to *Lactobacillus plantarum* in all other respects. Therefore, a number of pure cultures of this species from various sources were tested for nitrate reduction.

Thirty-eight cultures of *L. plantarum* were tested by growing in indole-nitrite medium (Baltimore Biological Laboratory) for 3 days and by testing for the presence of nitrites with sulphanilic acid and α-naphthylamine (*1*). Of these cultures, 18 were able to reduce nitrate in this medium (Table 1). The addition of zinc to the other cultures indicated that no reduction had occurred. The results of replications of this experiment were identical.

Table 1. Reduction of nitrate by strains of *Lactobacillus plantarum*.

Source	No. of cultures	No. of cultures	
		Reduced nitrate	Nitrate not reduced
A.T.C.C.*	6	3 (8014)†	3 (8292)
N.R.R.L.‡	1	0	1 (B-227)
C. S. Pederson	3	0	3 (7-4)
Cucumber fermentations	28	15 (L-20)	13 (A-91-3)
Totals	38	18	20

* American-type culture collection.
† Numbers in parenthesis are representative strains.
‡ Northern Regional Research Laboratory.

It has been established by a number of investigators (*2*) that oxygen tension is a very important factor in the ability of bacteria to reduce nitrates. Also, the composition of the medium used may influence the results obtained. Thus, an experiment was conducted using two strains of *L. plantarum* that were found to reduce nitrates in indole-nitrite medium and one strain that did not. These strains were grown in five mediums, each containing 0.1-percent KNO_3, and tested over a period of 4 days for nitrate reduction.

The results of this experiment are given in Table 2. It is obvious that the oxygen tension of the mediums was the most important factor in nitrate reduction by strains A.T.C.C. 8014 and L-20. These cultures were unable to reduce nitrates in either nitrate broth or indole-nitrite medium with the 0.1-percent agar omitted. They reduced nitrates in all mediums containing 0.1-percent agar. However, the addition of yeast extract and agar to nitrate broth resulted in a positive test for nitrite 1 day earlier than when only agar was added. Strain B-227 failed to reduce nitrate in any medium. This experiment was repeated with five additional cultures of *L. plantarum* (three positive and two negative for nitrate reduction) with the same results.

Table 2. Relation of medium to nitrate reduction by *Lactobacillus plantarum*.

Medium	Incubation time (days)	Strain of *L. plantarum*		
		A.T.C.C. 8014	L-20	B-227
Nitrate broth (Difco)	1	–*	–	–
	2	–	–	–
	3	–	–	–
	4	–	–	–
Nitrate broth + 0.1%-agar	1	–	–	–
	2	–	–	–
	3	+	+	–
	4	+	+	–
Nitrate broth + 0.1%-agar + 0.3%-yeast extract	1	–	–	–
	2	+	+	–
	3	+	+	–
	4	+	+	–
Indole-nitrite medium (BBL)	1	–	–	–
	2	+	+	–
	3	+	+	–
	4	+	+	–
Indole-nitrite medium without agar	1	–	–	–
	2	–	–	–
	3	–	–	–
	4	–	–	–

* All tests run in duplicate: –, nitrate not reduced; +, nitrate reduced.

It is apparent from these data that the descriptions of the family Lactobacteriaceae and of the genus *Lactobacillus*, as now given in *Bergey's Manual* (*3*), should be changed in order to permit the inclusion of certain species that reduce nitrates. Further work is in progress in this laboratory to determine the advisability of making a separate species of those cultures that reduce nitrates.

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* Journal Article No. 1672.
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21 October 1954.

A Method for Rapidly Transferring a Substance on Paper to the Origin of a Chromatogram

Garold F. Gregory

Institute for Atomic Research and
Department of Botany and Plant Pathology

A simplified method has been devised for eluting a substance separated by means of paper chromatography and for transferring it to the origin of another chromatogram (*1*). This technique is novel only in its simplicity and apparatus requirements. Methods for rapid elution (*2*) and transfer to the origin of a chromatogram are in use, but they require special apparatus; on the other hand, methods requiring standard laboratory apparatus (*3*) are slow and time consuming for the experimenter.

A schematic presentation of the apparatus used is shown in Fig. 1. The apparatus consists of a hair dryer that is directed toward the origin of the chromatogram, two flat plates with a 1-in. central, circular cut, and a beaker. The manner in which the spots are cut for elution and transfer to the origins of other chromatograms is shown in Fig. 2.

The cutout is attached to another strip of filter paper by means of a basket weave or by lacing with platinum wire. The attachment by means of platinum wire is quicker, but it does not establish the paper-to-paper contact as well as the basket weave. The paper strip is then folded, and the sides are stapled together, thus forming what may be called a transfer wick, which is self-supporting in a beaker. The transfer wick is cut so that the pointed tip just makes contact at the origin. Its length can be adjusted if the basket weave is used. If greater stability of the transfer wick is desired, a paper strip approximately one-half the height of the beaker is cut and the ends are stapled together, forming a ring slightly smaller than the beaker. The paper with the substance to be transferred is attached to this ring by the basket-weave or platinum-wire method.

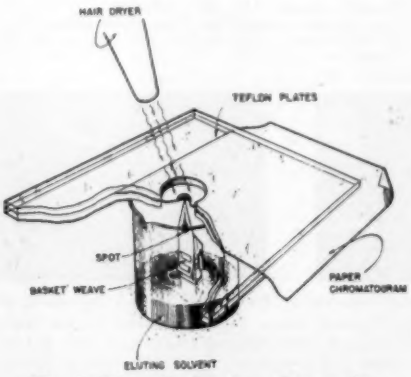

Fig. 1. Schematic drawing of apparatus.

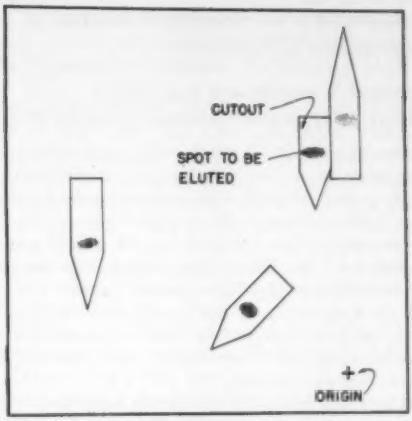

Fig. 2. How spots are cut for elution.

One of the chief advantages of this technique is control of spot size, which is regulated by controlling the air-current velocity. It is quite easy to overload the origin so care must be exercised. This technique was checked by the application of tropaeolin 000 to a transfer wick. With water it appeared to be eluted quantitatively within 2 hr.

It is possible to avoid attaching a paper strip in making a transfer wick from a one-dimensional chromatogram by allowing 1½-in. margins at the origin. This allows for the base of the transfer wick to sit in the eluting solvent without coming in contact with the band of material to be eluted. The opposite margin is allowed for the shaping of the tip.

This method is obviously adaptable to the continuous transfer of substances in solution to the origin of a chromatogram, thus avoiding the tedious, discontinuous application of aliquots from a micropipette.

Chromatographic fractionation can be achieved by an elaboration of this technique. The material should be applied to the transfer wick in a narrow band about ¼ in. above the eluting solvent level. (The transfer wick is made of a single strip of filter paper that is shaped, folded, and stapled.) The chromatograms are changed several times in the course of the elution. Thus the material is fractionated one-dimensionally before being chromatographed in two dimensions. Alternatively, the chromatogram could be a narrow strip that is moved from point to point at predetermined times. A one-dimensional microfractionation is thus achieved.

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21 October 1954.

Immunochemical Studies of Human Plasma Beta Lipoprotein

Leonhard Korngold and Rose Lipari

Sloan-Kettering Institute for Cancer Research, New York

Recently several reports have appeared on the immunochemistry of beta lipoproteins (*1*, *2*). The use of the quantitative precipitin technique in these studies required antigens with a high degree of immunological purity. This difficulty may be partly overcome by means of the agar-diffusion technique developed by Ouchterlony (*3*). The present report (*4*) deals with the application of this technique to the immunological properties of human beta lipoproteins of densities less than 1.063 (low-density beta) obtained from several human plasmas.

Antiserums against fraction III were prepared by immunizing two rabbits with 50 mg of lyophilized fraction III (*5*) incorporated in Freund adjuvant, injected intramuscularly. Three weeks later the rabbits were bled, and the serums, which were immunologically identical, were pooled. Two other rabbits were also injected twice with Freund adjuvant to which had been added 2 ml of fresh preparations of beta lipoproteins prepared by the flotation technique (*6*). Both rabbits were bled 3 wk after the first injection, and the serums were used separately.

Low-density beta from normal women and patients with cancer of the breast were prepared by combining Cohn's method 10, as modified by Lever *et al.* (*7*), with the flotation technique of Gofman (*6*). Fractions I + II + III, fractions IV + V, and fraction VI were also prepared by the Lever modification of Cohn's method 10 (*7*). These preparations, as well as the patients' plasmas, were obtained from Marion Barclay (*8*).

Fraction II (*5*) and the saline-soluble material of fraction III (*5*) were also tested. All antiserums and antigens were tested by the agar-diffusion technique of Ouchterlony (*3*), slightly modified for this work (*9*).

Bjorklund had previously shown that antigen-antibody precipitates in agar could be stained if the antigen was a mucoprotein (*10*). We found that precipitates that contained lipoproteins could be stained specifically by using the lipid stains Sudan Black B (*11*) or Oil Red O (*12*).

Several lines were produced when antiserums against fraction III reacted with human plasma or the preparation containing fractions I + II + III (Fig. 1). No lines were obtained with fractions IV + V, fraction VI, or fraction II. Only one line was produced with the low-density beta of healthy women or patients (Fig. 2). The identity of the line caused by lipoproteins could be ascertained by staining the precipitates with either Sudan Black B or Oil Red O.

When saline-soluble material of fraction III was tested no line corresponding to the lipoproteins appeared, indicating that the lipoproteins in this fraction were insoluble. In order to to compare anti-fraction III serums with antiserums against recently prepared lipoproteins, low-density beta was placed in the center reservoir and the various antiserums were placed in the other four reservoirs. Typical reactions of identity were obtained (Fig. 3). This suggests that at least part of the antigenic structure of the beta lipoproteins of fraction III remained unaltered, even though the lipoproteins were insoluble.

The identity of the proteins responsible for the lines in fractions I + II + III, other than the one caused by low-density beta, is as yet undetermined. Ultracentrifuge studies have shown that the beta lipoproteins are composed of units with different flotation rates; this may be due to differences in protein-lipid composition (which would affect the size and density of the molecules) rather than to the presence of immunologically heterogeneous lipoproteins (*13*).

Gitlin (*1*) presented data that suggested the immunological heterogeneity of the beta lipoproteins. His studies included Oudin tests that gave rise to 5 or 6 lines with his beta-lipoproteins fraction. However, no evidence was presented that all the antigens responsible for these lines were lipoproteins, and consequently his results may have been due to contaminating proteins. Future work with more potent antiserums may disclose the presence of other beta lipoproteins.

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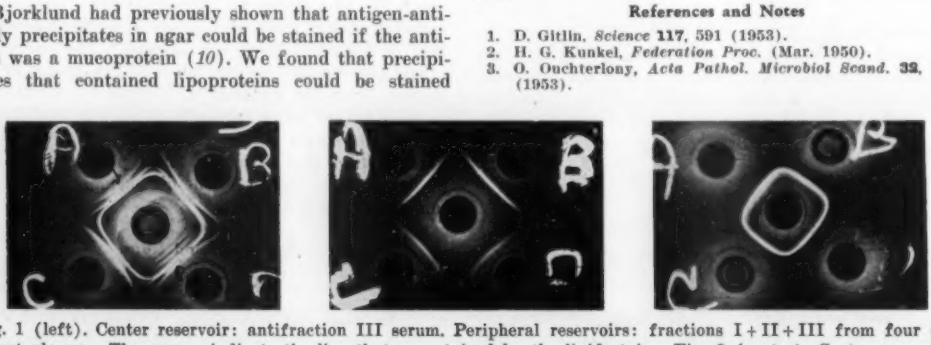

Fig. 1 (left). Center reservoir: antifraction III serum. Peripheral reservoirs: fractions I + II + III from four different plasmas. The arrows indicate the line that was stained by the lipid stains. Fig. 2 (center). Center reservoir: antifraction III serum. Peripheral reservoirs, low-density beta obtained by centrifuging fractions I + II + III at density less than 1.063. Fig. 3 (right). Center reservoir: low-density beta. Top reservoirs: antiserums against low-density beta. Bottom reservoirs: Antiserums against fraction III.

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13 October 1954.

Provisional New Type of Group A Streptococci Associated with Nephritis

Elaine L. Updyke, Merry Selman Moore, Elizabeth Conroy

Communicable Disease Center, U.S. Public Health Service, Department of Health, Education, and Welfare, Atlanta, Georgia

During the summer and fall of 1953 an outbreak of streptococcus infections was observed among children at the Red Lake Indian Reservation in Minnesota. Kleinman (*1*) has described the clinical manifestations of sore throat, tonsillitis, scarlet fever, and, particularly, acute glomerulonephritis and pyoderma. The outbreak had reached epidemic proportions by September 1953, at which time the Communicable Disease Center was invited to cooperate with the Bureau of Indian Affairs and the Minnesota Department of Health in an epidemiological investigation. This paper (*2*) deals with the bacteriologic aspects of the resulting study.

Because of limited laboratory facilities at the reservation, the cultures were sent on Loeffler's slants to the Minnesota Department of Health Laboratory in Minneapolis, where the primary isolations were made by one of us (M.S.M.). Isolates of beta hemolytic streptococci were mailed to the Streptococcus Laboratory in Chamblee, Georgia, for serologic identification.

Group A streptococci were isolated from 42 individuals at Red Lake and from six of a "control" group at the Cass Lake Indian Reservation 50 mi away. Each of the 48 cultures was tested with precipitating antiserums for types 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14, 15, 17, 18, 19, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 32, 33, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, and 47 (*3*). Since none of the cultures reacted with these antiserums, rabbits were immunized with two of the Red Lake cultures: DS-C300, from a nose and throat culture of a child with albuminuria but with no clinical nephritis, and DS-C274, isolated in almost pure culture from a skin lesion of a child with acute glomerulonephritis. A satisfactory antibody response to C300 was obtained after three immunization series: the first with a vaccine prepared by the standard procedure (*4*), the second and third with "glow-bead" vaccines (*5*). The data presented here are based on results obtained with antiserum against C300. Preliminary tests with C274 antiserum were confirmatory.

The C300 antiserum reacted with a majority of the 42 Red Lake cultures, including C274, and with three of the six Cass Lake cultures. It did not react with any of the aforementioned types or with two provisional types that were available for study. Results of the tests with the Red Lake cultures are shown in Table 1. Of particular interest is the fact that the C300 antiserum reacted with 12 (92 percent)of the 13 cultures from children with clinical nephritis and with 17 (100 percent) of the cultures from those with pyoderma, the two lesions most characteristic of the epidemic.

In view of the experimental results, we believe that the C300 culture is representative of a serologically specific strain of group-A beta hemolytic streptococci and that its antiserum has characterized the etiological agent of the Red Lake epidemic. Therefore, we propose that any culture reacting with C300 antiserum be referred to as a Red Lake strain until

Table 1. Serologic reactions of group-A streptococci isolated from 42 individuals at Red Lake Indian Reservation.

Diagnosis of individual from which strain isolated	Streptococcal strains reacting with: Antiserum to Red Lake strain (DS-C300) only		No available antiserums including DS-C300 (untypable*)		Totals	
Nephritis only	3	12	1	1	4	13 nephritis
Nephritis and pyoderma	9		0		9	
Pyoderma only	8	17†	0	0	8	17 pyoderma
Sore throat, tonsillitis, or scarlet fever	2		3		5	
No clinical disease	5		11		16	
TOTAL	27 (64%)		15 (36%)		42 (100%)	

* Tested with antiserums for types listed in text.
† Eleven cultures from skin lesions, six from nose and throat.

further work has established either (i) the validity of the strain as a new type, to be assigned a number in accordance with the recommendations of the International Bacteriological Nomenclature Subcommittee on Streptococci and Pneumococci, or (ii) its identity with a previously recognized type.

Whatever the outcome of future serologic studies with the Red Lake strain, there is no doubt that, under some circumstances, it is nephritogenic and must therefore be taken into account, together with types 12 and 4, in studies on the relationship of group-A streptococci to acute glomerulonephritis.

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Accumulation of Arginine in Plants Afflicted with Iron-Deficiency Type Chlorosis

Robert W. Holley and John C. Cain

New York State Agricultural Experiment Station, Cornell University, Geneva

Iron deficiency in plants leads to the development of a characteristic chlorosis of the leaves. The same type of chlorosis develops when certain plants are grown in calcareous soil, and since analyses of the foliage often show an adequate iron content, this lime-induced chlorosis apparently results from a failure of iron to function in metabolic processes (*1, 2*). The same type of chlorosis also results from other treatments, such as the presence of nickel or cobalt (*3*), which apparently interfere with the function of iron.

Plants afflicted with the iron-deficiency type of chlorosis are known to have an increased content of soluble nitrogen in the foliage (*4*). This suggests that iron may be involved in nitrogen metabolism, a view that is supported by the observation that plants suffering from lime-induced chlorosis frequently recover if nitrogen is supplied as ammonium salts rather than as nitrates (*2, 5, 6*). Most of the available information on the nitrogen metabolism of chlorotic plants is furnished by the extensive analyses of nitrogenous fractions in chlorotic and green plants that have been reported by Iljin (*4*). Iljin has concluded that

> . . . residual nitrogen compounds [that is, nitrogen compounds not accounted for as ammonia, amide, protein, or amino nitrogen] are absent in healthy foliage or are present in small amounts only, but may account for 40 to 65 percent of the soluble nitrogen in chlorotic plants.

It seemed to us that the identification of this unknown nitrogenous material would be of interest and might give some clue to the nature of metabolic changes associated with iron deficiency.

Chlorotic and green blueberry, apple, and magnolia leaves were fractionated, and the free amino acids were identified by paper chromatography. The leaves were extracted with 80-percent alcohol and the extract was diluted with one-fifth of its volume of water and mixed with an equal volume of chloroform. The aqueous layer was separated, diluted with water, and the amino acids were adsorbed in a Dowex 50 column. The amino acids were eluted with 10-percent ammonium hydroxide, and the eluate was evaporated to dryness in high vacuum over phosphorus pentoxide.

Table 1. Comparison of composition of chlorotic and green leaves.

Description	Dry weight (mg/cm²)	Nitrogen (μg/cm²)			
		Total	80-percent alcohol-soluble	Total amino acids	Arginine
Blueberry, chlorotic*	6.1	195	44	25	21
Blueberry, chlorotic (Co)†	3.5	149	55	35	28
Blueberry, chlorotic (Ni)‡	5.2	161	37	27	24
Blueberry, green§	8.1	191	18	3	1
Apple, chlorotic‖	3.1	115	19	11	6
Apple green#	3.8	122	7	1	0
Magnolia stellata, chlorotic**	3.4	150	31	16	13
Magnolia stellata, green††	5.1	132	11	1	0

* Average of 12 plants, both field samples and sand culture.
† Cobalt-induced chlorotic plant grown in sand culture.
‡ Average of three nickel-induced chlorotic plants grown in sand culture.
§ Average of 14 control plants, both field samples and sand culture.
‖ Average of two plants, pot culture, wet.
Average of two plants, pot culture, dry.
** Average of two samples of chlorotic leaves.
†† Average of two samples of green leaves from the same plant.

Table 2. Data showing recovery from nickel-induced chlorosis in blueberry plants following treatment with ferrous ethylenediaminetetraacetate.

Description	Dry weight (mg/cm²)	Nitrogen (μg/cm²)			
		Total	80-percent alcohol-soluble	Total amino acids	Arginine
Chlorotic, before treatment	5.1	183	44	32	28
4 days after treatment*	4.7	169	43	31	28
13 days after treatment	6.8	139	14	4	3
26 days after treatment	6.9	107	11	1	0.2

* Approximately 30 ml of ferrous ethylenediaminetetraacetate solution containing 20 ppm of iron was injected into a branch bearing four actively growing shoots. Almost complete regreening had occurred after 26 days.

The dried samples were stored at −18°C. Aliquots were chromatographed quantitatively on Whatman No. 1 paper using procedures similar to those of Levy and Chung (*7*) and Thompson and Steward (*8*). (The data have not been corrected for any losses that may have occurred during the isolation procedure. Controls indicated that the recoveries of amino acids were at least 80 percent.) The content of arginine in the samples was also determined colorimetrically (*9*), using the difference between determinations before and after treatment with arginase. Results are expressed in terms of leaf area. Total nitrogen and 80-percent-alcohol-soluble nitrogen were determined by the micro-Kjeldahl method.

The results (Tables 1 and 2) indicate that an accumulation of free arginine is characteristic of the nitrogen metabolism of plants afflicted with iron-deficiency chlorosis. The disappearance of free arginine during recovery from chlorosis is shown in Table 2. Amino acids, other than arginine, that commonly occur in the leaves studied are (identification by position on the chromatogram) alanine, aspartic acid, asparagine, glutamic acid, and glutamine, with occasional traces of γ-aminobutyric acid, glycine, lysine, proline, serine, threonine, and valine.

Three of the four nitrogen atoms present in arginine (the three nitrogens in the guanidino group) would have been missed by Iljin's analyses and would have been included in his "residual nitrogen" fraction. Therefore, a high free-arginine content, which seems to be characteristic of chlorotic leaves, would account for the "residual nitrogen" described by Iljin.

It is of interest in connection with the findings reported here (*10*) that von Euler and Burström (*11*) found a high free-arginine content in the white borders of leaves of a variegated *Pelargonium* plant. (Leaves from two other variegated plants showed normal arginine content.) It should also be mentioned that Hewitt *et al.* (*12*) have reported that free arginine increases more than other amino acids during manganese deficiency in cauliflower, and these authors suggest that manganese is involved in amino acid metabolism.

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7 October 1954.

Differential Sensitivity of the Eye to Intermittent White Light

G. H. Mowbray and J. W. Gebhard

Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Maryland

The eye has often, in the past, been scorned as a temporal analyzer, the ear always seeming to take precedence. Strangely, few data exist that allow a direct, valid comparison between the two modalities. This paper (*1*) reports the results of an experiment that measured the speed of response of the human eye in a new way. The procedure was to measure the difference-limens for intermittent white light at 16 frequencies in the range of 1 to 45 cy/sec.

The intermittent stimulus light was produced by a Sylvania R1131C glow-modulator tube operated independently from two variable-frequency square-wave generators. Glow-modulator tubes follow precisely an electric input, and the square-wave generator was determined to have an accuracy of 0.5 percent in the range of the frequencies studied.

The stimulus spot provided by the tube subtended 1° of visual angle and had a homogeneous luminance of 98 millilamberts. It appeared in the center of a white surround subtending 71° held at a luminance of 44 millilamberts.

Table 1. Difference-limens for intermittent white light. Data from two practiced observers.

Standard frequency (cy/sec)	Average deviation (cy/sec)	$\Delta f/f$
1	0.010	0.010
2.5	.063	.025
5.0	.157	.031
7.5	.100	.013
10	.151	.015
12.5	.215	.017
15	.238	.016
17.5	.398	.023
20	.614	.031
22.5	.683	.031
25	.516	.021
27.5	.411	.015
30	.328	.011
35	.168	.005
40	.237	.006
45	.358	.008

The observer sat in a room darkened except for the light of the surrounding field. He viewed the standard and comparison frequencies successively on the same tube and selected, by a switch, the frequency he wanted to view. He also controlled the frequency of the comparison stimulus by a linear multirevolution potentiometer. Equality judgments were obtained by the method of adjustment, using ascending and descending matches alternately. The discrepancy between the standard and the comparison frequency was measured with an electronic counter to an accuracy exceeding that of the generating equipment. At least 20 thresholds were obtained from each of two practiced observers for all 16 frequencies.

Since the results from both observers were in agreement, their data have been pooled in Table 1 and Fig. 1. Columns 1 and 2 of the table show the standard frequency and the average deviation or average absolute error, of the comparison frequency from each standard. The average deviation is seen never to exceed about 0.6 cy/sec, while for the lower frequencies it is sometimes less than 0.1 cy/sec. Most striking, however, is the sharp rise in the threshold between about 15 and 22.5 cy/sec with a subsequent sharp decline to the region of 30 to 35 cy/sec. The threshold then rises as the fusion point is approached. Fusion for the conditions obtaining here was slightly more than 50 cy/sec for both observers.

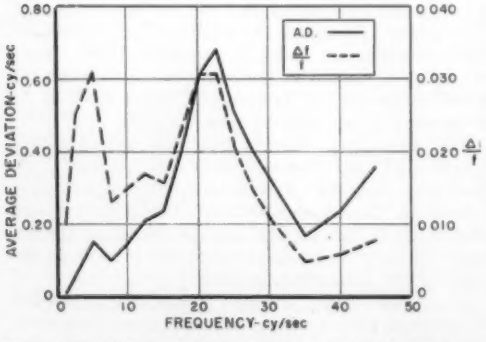

Fig. 1. The difference-limen function for flicker. The average deviations and the relative difference-limens shown on the ordinates are from columns 2 and 3 of Table 1.

Column 3 shows the relative difference-limen, $\Delta f/f$, for each frequency. The range of $\Delta f/f$ values is about 0.005 to 0.030, and 10 of the 16 points fall below 0.02. This is a rather respectable performance for an organ that is thought to have little temporal resolution. Even more impressive is the fact that, at a flicker rate of 35 cy/sec, the average absolute error of the judgments with respect to time is about 130 μsec. That is to say, when the period of the standard differs from that of the comparison by 130 μsec, the eye detects a difference.

Table 2. A comparison of relative difference-limens for auditory flutter and photic flicker.

Standard frequency (cy/sec)	Flutter ($\Delta f/f$) 50 db (sensation level)	Flutter ($\Delta f/f$) 100 db (sensation level)	Flicker ($\Delta f/f$)
20	0.100	0.100	0.031
40	.150	.075	.006
80	.162	.075	
120	.208	.083	
160	.250	.094	
240	.333	.217	
320	.459	.459	

Another facet of this problem concerns the number of just noticeable differences in the stimulus range investigated. This range is limited by the fusion point, but where the other end terminates is purely arbitrary. There is doubt that anything below about 5 cy/sec is really flicker or that the same criterion of judgment can be used as with the higher frequencies (*2*). Be that as it may, the integration of difference-limens by graphic methods yields 280 just noticeable differences for photic flicker between 1 and 45 cy/sec. This is a very creditable number. Indeed, the number of such differences in pitch that can be discriminated is only 6 times as large for a frequency range nearly 450 times as great (*3*).

Only one investigation in audition yields data comparable to those reported here. Miller and Taylor in 1948 studied difference-limens for interrupted white noise, or what they called "flutter" (*4*). It is of interest to relate the differential sensitivity for flutter and flicker despite two serious difficulties in doing so. One is that the frequencies used by Miller and Taylor overlap only two of the data points in the flicker experiment. The other is that a different method of obtaining the difference-limens was used—one that prob-

ably resulted in higher thresholds than those obtained here.

Table 2 compares the two sets of data at the points where a comparison is possible. The wide discrepancy that exists for interruption rates of 20 and 40 cy/sec is in favor of the eye. It is hard to believe that the eye can beat the ear at its own game. Since the differences in method might explain this discrepancy, it is hoped to put the matter to the test soon.

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22 October 1954.

Communications

Explanation of the Effect of Feeding Desiccated Thyroid on the Incidence of Dental Caries in the Rat

Muhler and Shafer (*1*) have recently produced convincing experimental evidence that the feeding of desiccated thyroid has a marked anticariogenic effect in the rat. It is, in fact, as effective as the administration of sodium fluoride. They have also shown that there is an increased incidence of dental caries in rats when the level of thyroid hormone in the blood is lowered by "blocking" the thyroid with thiouracil. Their work leaves no doubt that thyroid activity is related in some manner to the incidence of dental caries in the adult rat.

We would like to suggest a possible explanation for this relationship. It has recently been postulated that the submaxillary and parotid salivary glands in the rat function to control the level of thyroid hormone in the blood stream by degrading it to iodide ion (*2–5*). The iodide ion is then recycled to the thyroid gland via the saliva and the gastrointestinal tract. This explains the long-known ability of the salivary glands to concentrate iodide and means that the concentration of iodide in the saliva will depend on the rate of thyroxine degradation if the dietary iodide does not vary.

A convenient explanation of the results of Muhler and Shafer would be that it is the increased concentration of iodide ion in the saliva and/or the increased saliva flow resulting from the stimulation of the degradative processes in the salivary glands that accounts for the effect of feeding desiccated thyroid. The increase in the incidence of dental caries noted when thiouracil was fed, may well have been caused by a decrease in the level of iodide in the saliva and a decrease in the rate of saliva flow associated with a diminished rate of degradation of the thyroid hormone. It is well established that a diminution in the rate of salivary flow has a marked effect on the incidence of dental caries in experimental animals (*6*) and it is possible that iodide ion, like a variety of other substances, has an anticariogenic action when it is in solution in the saliva.

There are many reports in the literature which indicate that hyperfunction of the salivary glands is associated with hyperthyroidism. Thus Moehlig, in a review (*7*), states that obvious swelling of the salivary glands is often associated with hyperthyroidism, and he quotes references to other workers who have observed the same phenomenon. Moehlig also states that hypersalivation is often a troublesome symptom in hyperthyroidism and quotes other workers who have also observed this. Hammerli (*8*) observed, in a study of 197 autopsies on goiter patients, a hypertrophy of the submaxillary salivary glands. The extent of hypertrophy was related to the size of the goiter. Albright, Larson, and Deiss have recently reported (*9*) transient swelling of the parotid and submaxillary salivary glands in a myxedematous patient after the administration of triiodothyronine.

In the rat, both thyroidectomy and the administration of thiouracil or thiourea result in marked atrophy of the submaxillary salivary gland (*10–12*). This atrophy, both in the case of thyroidectomized and thiouracil-fed rats, can be prevented by the administration of thyroid hormone (*10–12*). In view of the recent direct experimental demonstration that the salivary glands in the rat are concerned with the extrathyroidal metabolism of organically bound iodine (*4*), this atrophy is very probably the result of the cessation of the degradative function in the submaxillary gland. It would appear reasonable to assume that this would result in a diminution in the concentration of iodide ion in the saliva, along with a decreased saliva flow. The feeding of desiccated thyroid has been shown to result in an increase in the weight of the submaxillary gland of the rat (*12*). This is very probably caused by the increased degradation of the excess thyroid hormone, which would result in an increased concentration of iodide ion in the saliva and, perhaps, to an increased flow of saliva.

In summary, there is evidence both from the clinical literature and from work on experimental animals that there is hyperfunction of the salivary glands in hyperthyroidism and hypofunction of the salivary glands in hypothyroidism. We feel that the anticariogenic action of desiccated thyroid may well result

from an increased flow of saliva and/or increased concentration of salivary iodide. The cariogenic action of the antithyroid substances is the result of the reverse conditions. This concept, should it prove to be true, is of considerable theoretical and practical interest. It provides a possible explanation for the predisposition to dental caries in certain individuals and opens the possibility of providing a new method for the control of dental caries. For these reasons we feel that this idea should be drawn to the attention of interested workers.

E. J. RYAN

Dental Digest,
708 Church Street, Evanston, Illinois

S. KIRKWOOD

Department of Chemistry,
McMaster University, Hamilton, Ontario

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New Antiarthritic Steroids

At a recent meeting of the American Rheumatism Association (*1*) the clinical effectiveness of two new, potent antiarthritic steroids, metacortandracin (Meticorten) (*2*) and metacortandralone (Meticortelone) (*3*) was described. The structures of these compounds are, respectively, $\Delta^{1,4}$-pregnadiene-17α, 21-, diol-3, 11, 20-trione (I) and $\Delta^{1,4}$-pregnadiene-11β, 17α, 21-triol-3, 20-dione (II).

Meticorten (I) melted at 233° to 235° dec., $[\alpha]_D^{25}+172°$ (dioxane), $\lambda_{max.}^{methanol}$ 238 mμ (ε = 15,500), $\lambda_{max.}^{Nujol}$ 3.04μ (OH), 5.84μ (11- and 20-carbonyls), 5.98, 6.16 and 6.21μ ($\Delta^{1,4}$-diene-3-one) (*4*). (*Anal.* found: C, 70.35; H, 7.45). Its 21-acetate derivative melted at 226° to 232° dec., $[\alpha]_D^{25}+186°$ (dioxane), $\lambda_{max.}^{methanol}$ 238 mμ (ε = 16,100), $\lambda_{max.}^{Nujol}$ 2.98μ (OH), 5.73 and 5.80μ (20-carbonyl, 21-acetate interaction) 5.85μ (11- and 20-carbonyls), 6.02, 6.16, and 6.20μ ($\Delta^{1,4}$-diene-3-one), 8.10μ (21-acetate). (*Anal.* found: C, 68.82; H, 7.13).

Meticortelone (II) melted at 240° to 241° dec., $[\alpha]_D^{25}+102°$ (dioxane), $\lambda_{max.}^{methanol}$ 242 mμ (ε = 15,000), $\lambda_{max.}^{Nujol}$ 2.96μ (OH), 5.82μ (20-carbonyl), 6.04, 6.19, and 6.25μ ($\Delta^{1,4}$-diene-3-one). (*Anal.* found: C, 70.24; H, 8.13). Its 21-acetate derivative melted at 237° to 239° dec., $[\alpha]_D^{25}+116°$ (dioxane), $\lambda_{max.}^{methanol}$ 242 mμ (ε = 15,000), $\lambda_{max.}^{Nujol}$ 3.0μ (OH), 5.71 and 5.78μ (20-carbonyl, 27-acetate interaction), 6.04, 6.13, and 6.22μ ($\Delta^{1,4}$-diene-3-one), 8.12μ (21-acetate). (*Anal.* found: C, 68.62; H, 7.78).

Adrenocortical activity of I and II measured by the eosinopenic response in adrenalectomized mice (*5*) was 3 to 4 times the activity of cortisone or hydrocortisone. The enhanced "gluco-corticoid" activity of the new steroids was confirmed by assays employing the liver glycogen deposition method in adrenalectomized rats (*6*) and the thymus involution method in intact mice (*7*).

Further details of synthesis, proof of structure, and biological activities of I and II will appear elsewhere.

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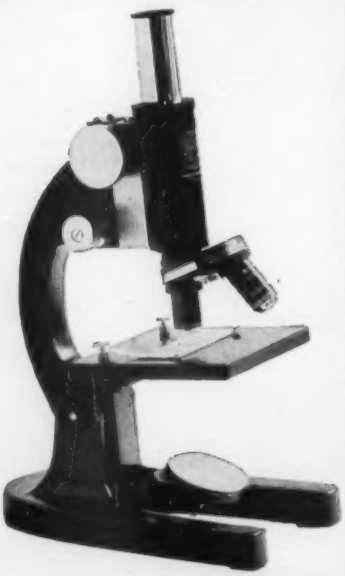

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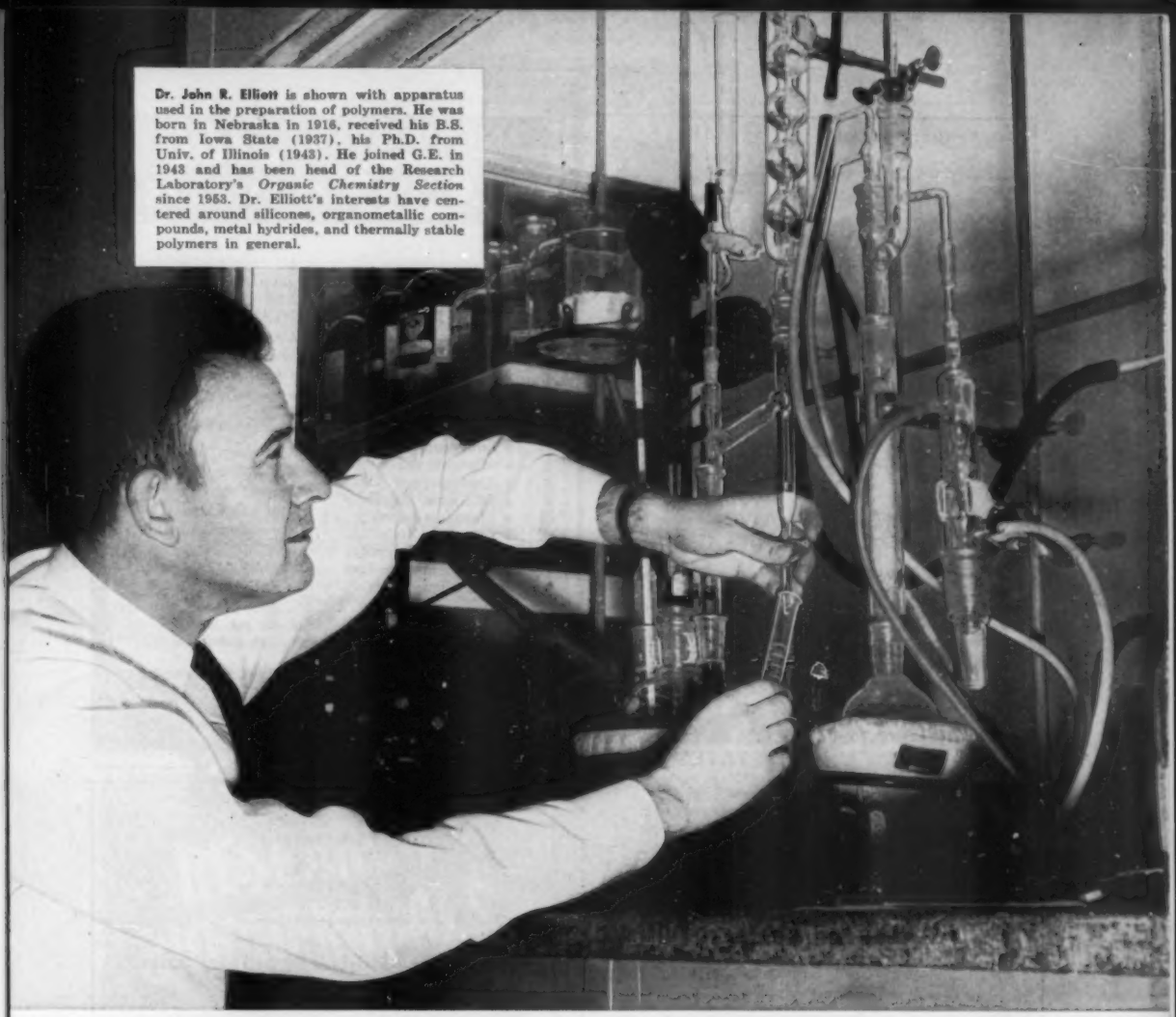

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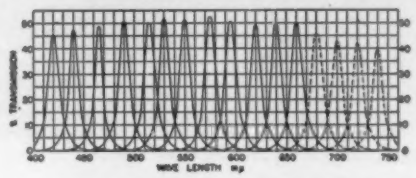

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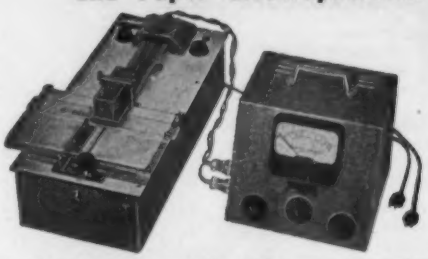

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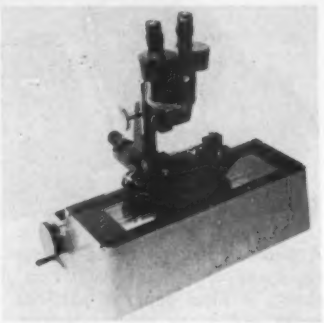

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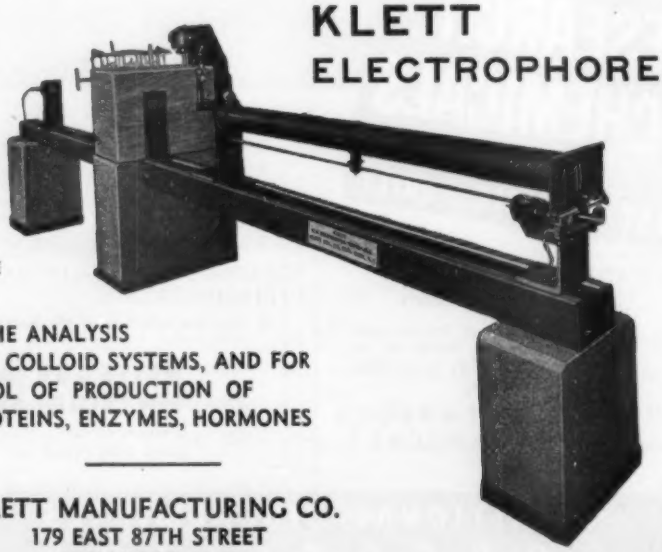

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Standards—A New Tool for Science

SCIENTIFIC research is moving ahead today at a faster pace than at any time in our history. For industrial research alone, this country is now spending twice as much as it did in 1940. New scientific discoveries have created vast new industries and enlarged existing ones. The electronic industry grew from $230 million before the war to $4½ billion in 1954. Instrument controls accounted last year for almost 10 percent of the nation's capital expenditures. Industrial use of atomic energy is just over the horizon. Since the war the manufacturing capacity of the United States has increased 65 percent. There is every indication that this expansion will continue.

The vast variety and complexity of scientific discoveries have also increased the complexity of our industrial economy. New production methods create new problems of an intricacy and magnitude never known before. Industrial interdependence is growing rapidly and is leading to further complexities.

One of industry's greatest jobs today is to translate the data of pure science and engineering into practical economical applications. The research scientist who ventures into new fields of discovery creates new data and terminology. Before these can be used they have to be brought into a common denominator with existing data, terminology, and practices. The tools to achieve such practical application are standards.

Without standards, duplication, overlapping, contradiction, and confusion are inevitable. At a recent conference of automation engineers and manufacturers, for instance, it was pointed out that in the new field of automatic controls, the same terms and symbols mean different things to engineers in the hydraulic, pneumatic, and electric fields. These people decided to develop a standard terminology for automatic controls. They need it before they can effectively standardize equipment and production methods involving automatic controls. In a competitive economy, the need for standards is dictated by economic pressures. All of our mass production methods rest on standardization. And mass production is the basis of our high standard of living.

As a result of voluntary cooperation and acceptance by many groups, nearly 1500 American Standards of nationwide application are now in daily use. Some 4000 technical experts and businessmen are presently working on committees under ASA auspices to develop new standards and keep approved ones up to date. Some 370 standardizing projects are now being carried forward, ranging from standard methods of tests and ratings for components in electronic circuits to safety standards for toys.

But existing methods of standards writing are not enough. Up to now most standards have been written when waste, confusion, and chaos made standardization almost imperative. The new industrial era demands a broadened use of standard techniques. New scientific discoveries and facts are accumulating faster than they can be converted into practical application.

In order to cope with this flood of new material and the complexities it creates, ASA is pleading with all concerned to accept a new method of standards writing. Standards should be pre-planned and written in anticipation of the needs that the rapid progress of our sciences creates. Pre-planned and coordinated standards are a key to a practical and efficient use of our new technologies. A lack of adequate standards may create a chaos that will prevent practical application of the scientist's work. Standards work done now, in advance of need, will not have to be done later—at a terribly increased cost in materials, manpower, and money. The comparatively simple steps taken in standards today can avoid complications that might take decades to unscramble.

The scientist's interest in standards is evident. The results of his research are not fully utilized if they are not translated into standard engineering and production practices. His cooperation in standards writing is needed as much as that of the engineer, manufacturer, businessman, consumer, and others who benefit from standards.

ROGER E. GAY, *president*
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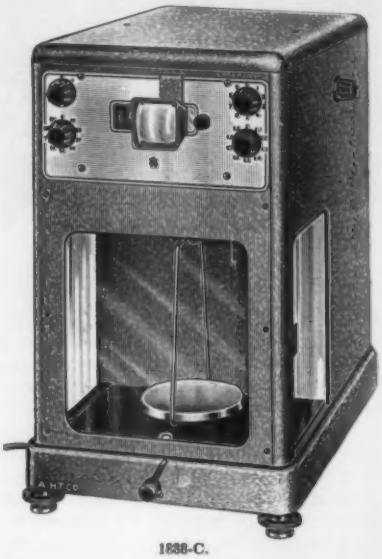

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It consists essentially of a probe unit containing a photoelectric tube for detecting light energy and an amplifier to which it is connected by a flexible cable. The amplifier incorporates a milliammeter calibrated to indicate either optical density on a "log" scale or percent transmission on a "linear" scale, depending upon the model.

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The meter in the percent-transmission model uses a standard meter movement and indicates percent transmission on a linear scale. This may also be considered as percent reflectance or percent incident light upon the phototube. The full range of the scale for the first position of the range switch is from 0 to 100% transmission. Other positions of the switch provide ranges of 0 to 10%, 0 to 1% and 0 to 0.1%, respectively. The lower scale on this meter is calibrated to read directly the optical density corresponding to the percent transmission indicated on the upper scale.

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9–11. American Cong. on Surveying and Mapping, 15th annual, Washington, D.C. (W. S. Dix, Room 435, Woodward Building, Washington 5.)

10–12. M. D. Anderson Symposium on Fundamental Cancer Research, Houston, Tex. (Univ. of Texas, M. D. Anderson Hospital and Tumor Institute, Houston.)

11–13. National Wildlife Federation, Montreal, Canada. (C. H. Callison, 232 Carroll St., NW, Washington 12, D.C.)

14. American Educational Research Assoc., Denver, Colo. (F. W. Hubbard, 1201 16 St., NW, Washington 6, D.C.)

14–16. North American Wildlife Conference, 20th, Montreal, Canada. (Wildlife Management Inst., 709 Wire Bldg., Washington 5, D.C.)

15–17. Electrical Utilization of Aluminum, American Inst. of Electrical Engineers, Pittsburgh, Pa. (N. S. Hibshem, AIEE, 33 W. 39th St., New York 18.)

17–19. American Physical Soc., Baltimore, Md. (K. K. Darrow, Columbia University, New York 27.)

17–19. International Symposium on Cardiovascular Surgery, Detroit, Mich. (John Keyes, Henry Ford Hospital, Detroit 2.)

17–2. Inter-American Statistical Conf., 3rd, Santiago, Chile. (IASI, Pan American Union, Washington 6.)

20–23. American Assoc. of Dental Schools, annual, Chicago, Ill. (M. W. McCrea, 42 S. Greene St., Baltimore 1, Md.)

20–23. American Inst. of Chemical Engineers, Louisville, Ky. (S. L. Tyler, AICE, 120 E. 41 St., New York 17.)

21–23. Aero Medical Assoc., 26th annual, Washington, D.C. (R. J. Benford, P. O. Box 1607, Washington 13.)

21–24. Latin American Electroencephalographical Cong., 2nd, Montevideo, Uruguay. (P. Pinto Pupo, Secretary-General, San Paulo, Brazil.)

21–24. Latin-American Neurosurgical Congress, 6th, Montevideo, Uruguay. (R. Arana-Iniguez, Convencion 1287, Montevideo.)

23–26. International Academy of Proctology, 7th annual, New York. (IAP, 43–55 Kissena Blvd., Flushing, N.Y.)

24–26. National Science Teachers Assoc., Cincinnati, Ohio. (R. H. Carleton, 1201 16 St., NW, Washington, D.C.)

25–26. Michigan Acad. of Science, Arts and Letters, E. Lansing, Mich. (George M. McEwen, Univ. of Mich., Ann Arbor.)

28–31. American Assoc. of Petroleum Geologists, New York, N.Y. (E. H. Powers, Box 670, Fort Worth, Tex.)

28–1. Western Metal Exposition, 9th, Los Angeles, Calif. (W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.)

29–7. American Chemical Soc., 127th national, Cincinnati, Ohio (A. H. Emery, 1155 16 St., NW, Washington 6, D.C.)

31–2. Soc. of Research in Child Development Monticello, Ill. (C. B. Stendler, College of Education, Univ. of Illinois, Urbana.)

April

1–5. Japan Medical Cong., Kyoto. (M. Goto, Univ. Hospital, Kyoto Univ., Kyoto.)

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